Traffic Engineering

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Traffic Engineering is that phase of engineering which deals with the planning and geometric design of streets, highways, and abutting lands, and with traffic operation thereon, as their use is related to the safe, convenient, and economic transportation of persons and goods.

COVER: The Nation's Capitol—the Number One seat of government in the U. S., and first on the list of sight-seers attending the Annual Meeting in Washington.

Photo by: Harris and Ewing Washington, D. C.

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LETTERS TO THE EDITOR

TIME-SPACE DIAGRAM

Please refer to the diagram on page 124 of your December 1948 issue.

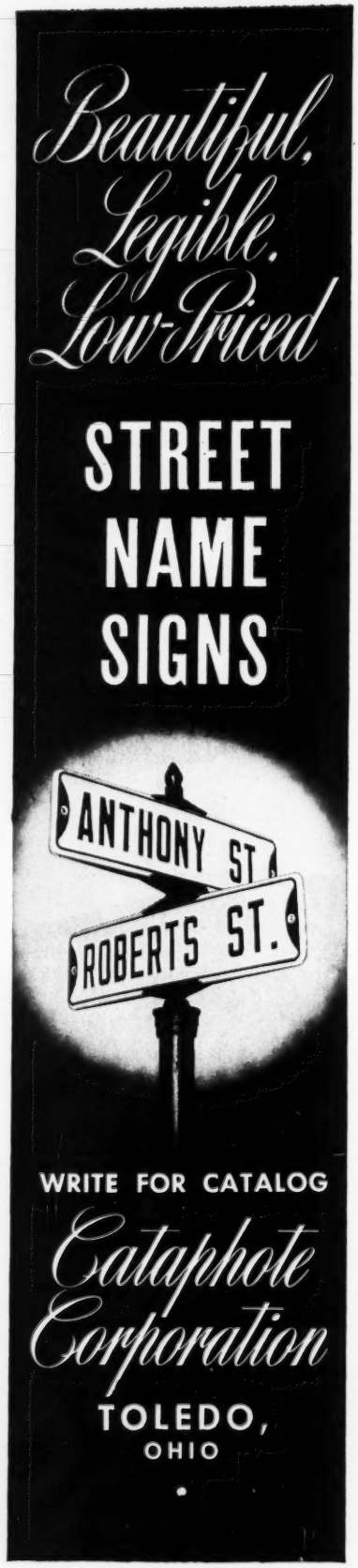
I should like to encourage the traffic engineers to plot their time-space diagrams for signal studies with the distance as the horizontal axis, and the time in seconds as the vertical axis. It has long been a standard among engineers to plot the ordinate as the variable or dependent quantity.

It is confusing to our students, and to others alike, to have to reverse our thinking and practice when referring to the time-space signal diagrams prepared by many traffic engineers.

I should like for you to consider this change in method and I do hope that it will receive consideration in the forthcoming revised edition of the "Traffic Engineering Handbook".

Robley Winfrey
Professor of Civil Engineering
Iowa State College
Ames, Iowa

•We are pleased to report that the time-space diagrams in the "Traffic Engineering Handbook" are plotted with the distance as the horizontal axis. A check with the Yale Bureau of Highway Traffic indicates that they follow the same general practice. Perhaps we should have positioned the diagram on page 124 of the December 1948 issue to conform with the accepted method of presentation. —ED.



TEEN-AGE DRIVERS

I believe that the information that is credited to the Institute of Public Safety, which appears on page 538 of the August issue of TRAFFIC ENGINEERING magazine, is beginning to get a little out of date.

It is true that some years ago a study was conducted which showed that 16-year olds in that study killed nine times as many people as those in the 45-50 age group and that the 15-19 year age group killed aboue five times as many.

Mr. Transeau of the Pennsylvania Bureau of Highway Safety issued a news release about a month ago stating that the record of the teen-agers now is better than it was six or eight years ago. I believe that the study conducted by the Center for Safety Education also shows that the record of the teen-agers in Connecticut has improved somewhat.

It is true that the teen-age record still needs much improvement. However, it is gratifying to note that apparently some improvement has been achieved in the past few years.

Joseph Intorre
Associate in Charge of Driver Testing
Institute of Public Safety
State College, Pennsylvania

BLANCHARD'S HIGH SPEED

A personality sketch in the July issue closed thus: "Any dubious readers may check this one personally with Mr. Blanchard". As the writer has received several letters and verbal comments, a brief statement is in order to save the valuable time of members of the ITE and explain the high speed act of a "safe and sane" driver.

The instance of travelling at a rate of 106 miles per hour in

Italy is of common occurrence when drivers are operating high speed cars on the four to eight-lane toll highways constructed by the Societa Anonima Autostrade. The writer was operating his Panhard, which has a maximum speed of 150 miles per hour.

In the United States, the writer has driven his Lincoln, manufactured by the late Lincoln Motor Car Company, at a speed of 110 miles per hour. The occasion was while the writer was consultant to the Michigan State Highway Department and was following the Governor from Lansing to Detroit, his Lincoln being preceded by a police escort.

Arthur Blanchard
Member, ITE
Newark, New Jersey.

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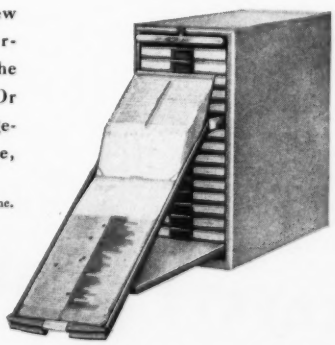

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And greet my friends, but ere I've greeted many,
I must go back and drop in one more penny.

I always liked to stroll through every shop,
Or drop in for a soda or some pop;
But now I worry least I'm in a pickle
If I don't hurry back with one more nickel.

Once leisurely, I now am full of bustle,
I snap at clerks and order them to hustle.
For courtesy and smiles I have no time
Unless I anté up another dime!

Hackettstown Gazette

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Frankly Speaking

A new *Institute* year begins—another year in which we shall work together towards greater professional achievements and a year in which we shall continue to contribute to the improvement of highway transportation. Each member has a job to do. There can be pleasant collective achievements through facilities of the Institute.

The profession of traffic engineering has come a long way. Many of the advances can be measured by achievements of the Institute: In 19 years the membership has grown from 30 to nearly 500. A full-time headquarters staff is now maintained under the direction of a capable Executive Secretary. It is only in recent months that a paid staff has been provided for our magazine—*Traffic Engineering*. Three student chapters have been organized and are actively engaged in furthering traffic engineering interest among engineering students. A Traffic Engineering Handbook published in 1940 has been widely acclaimed. The first edition has been out of print for two years, however, a revised and greatly improved edition is now ready for publication. The Annual Meetings of the Institute have grown rapidly in importance and size. They are increasingly looked upon as a major outlet for technical findings and are attended each year by approximately 300 people. Through technical committees, the Institute has cooperated with other transportation agencies and has contributed valuable research and investigative findings. Cooperative relationships with national and international organizations have been expanded.

This month, with this issue, *Traffic Engineering* passes another significant milestone. The increase in size, the enrichment in contents and the wider distribution will make the journal comparable with the best in the engineering field. Much is due the editorial and business staffs for the accomplishments. They well deserve the full support of every member of the Institute in assuring success for the magazine in its present form and in the future enlargement and expansion of this important organ.

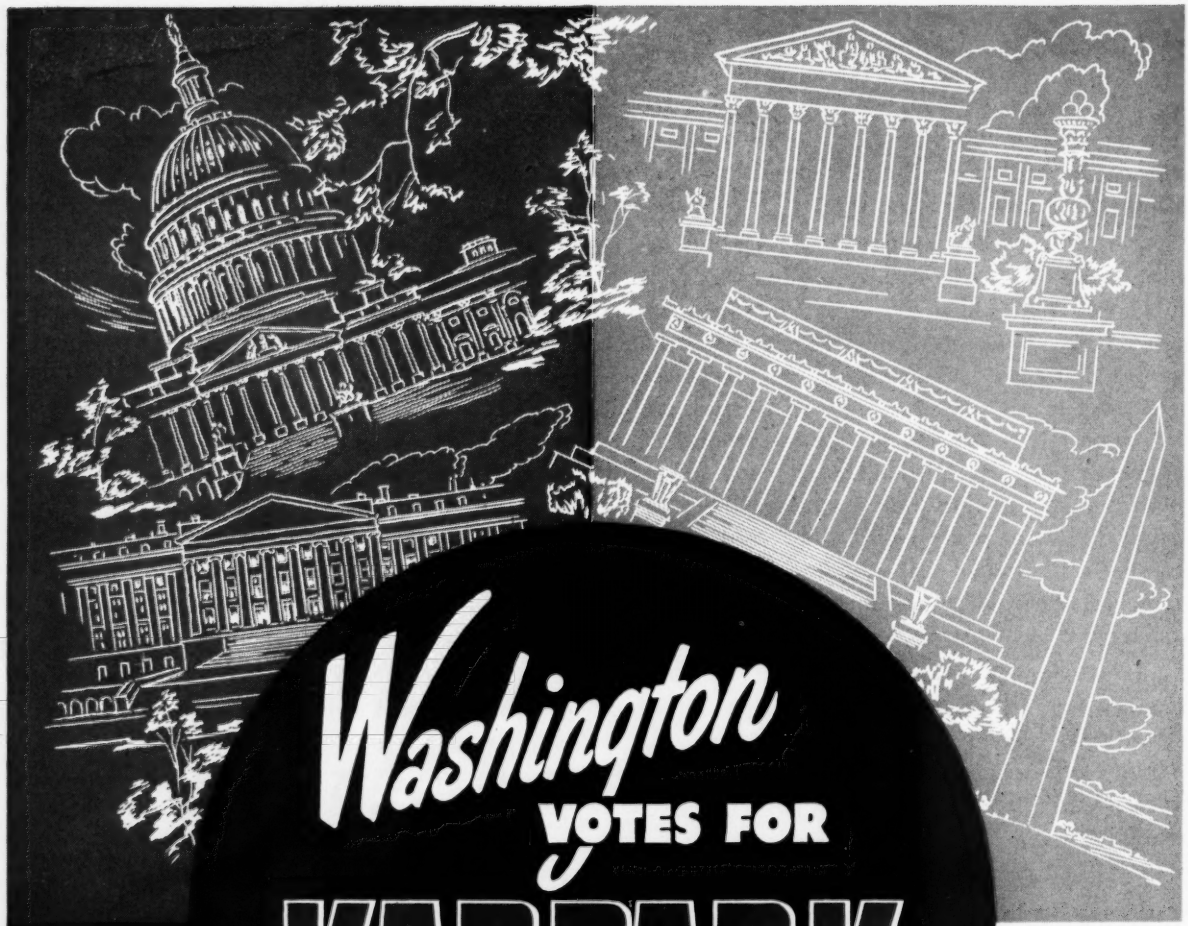
The growth of the profession and of the Institute has been very rapid. Progress has been rapid because the demands imposed by automotive transportation have been tremendous. It is often found that fast growth is not sound growth. We must be alert, therefore, to assure soundness and stability.

Many hardships have already been overcome. Many remain. The profession is still being watched carefully. The Institute has come a long way, but every achievement in a sense increases responsibility. The work of traffic engineers will always be in the public eye and as with other public endeavors will always be subject to much criticism.

It is easy to see now that initial traffic engineering concepts were sound, but in the development of traffic engineering as a *science* many technical aspects remain to be achieved. The needs for technological developments are paramount. Through research, and the application of facts, the profession can become a real scientific agency. While some of the older engineering societies are now urging members to turn from "all technical" to broader ways of life and to the rendering of "general services" it might be said that the converse is true of traffic engineering. The reverse may be true until the profession has become more technical. It is fortunate for traffic engineering that traffic engineers are not susceptible to "holed-in" activities. Their work, to be effective, must be a part of community life.

By banding together in the Institute, we have moved ahead a new field of activity that would have grown slowly through individual efforts. We must now advance our technology, make sound financial plans, and apply abilities for the public good. The contribution of individuals will add up to a collective achievement which will make possible the attainment of the high goals which the profession has set.

Wilbur S. Smith
President



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San Francisco Bay Vehicular Crossings

by T. T. McCrosky, *(Mem., ITE)**

Ed. Note: The author was retained by a special interim committee of the California legislature, of which Assemblyman Richard J. Dolwig is chairman. Associated with him were Messrs. O. H. Ammann and Ole Singstad, consulting engineers specializing in bridges and tunnels respectively.

In 1946-'47, the question of an additional vehicular crossing of San Francisco Bay was thoroughly investigated by a joint Army-Navy Board, whose final report recommended a combined causeway and six-lane tunnel at a location two and one-quarter miles south of the existing San Francisco-Oakland Bay Bridge.

In the spring of 1949, the California Toll Bridge Authority decided to build a second bridge, substantially identical, parallel and close to the present bridge, instead of constructing the Southern Crossing. It was this decision that prompted the California Assembly to undertake a restudy of the entire problem, to determine whether the "parallel bridge" is the best solution, or whether some other more satisfactory and less costly program of construction could be developed.

The following article summarizes the report of the three engineering consultants to the Assembly committee, which was filed on June 1, 1949. The recommendations of the consultants were adopted by the committee on June 24.

Planning and Traffic Considerations

THE intensive urban development served by the present Bay Bridge extends for a distance of approximately 18 miles on the San Francisco side and 24 miles on the Alameda side of the central and southern bay. Future industrial growth and much of the residential growth is expected to be primarily toward the south, on both sides of the bay.

It is axiomatic that intensively developed coastal areas of such great linear extent should be divided into two or more parts on each side of the water, and the separate parts then connected by separate crossings. If the second crossing were built immediately adjacent to the first, it would abet further undesirable concentration and congestion, and would fail to provide for the needs of actual and logical southward expansion. Excessive centralization and congestion can readily reach a point where decay becomes imminent, and a certain degree of preventative decentralization should now be encouraged.

It is the established practice in New York, Detroit, St. Louis, Cincinnati, and many other cities to construct their water crossings some distance apart, so that the convenience of many areas will be served, and overcentralization avoided.

The Joint Army-Navy Board made very clear that they considered a southern crossing preferable to the twin bridges, from the standpoint of national security. Although the destruction of both bridges in a single bombing attack would be unlikely, the experience of Pearl Harbor reminds us that *surprise* is an important factor in the art of war.

During a recent fire in San Francisco, the entrances and exits of the Bay Bridge were closed off. If the parallel bridge were to be built, there would always be the dangerous possibility that a conflagration or other disaster might close both bridges for a protracted period, thus severing all means of vehicular and transit travel between San Francisco and Oakland.

Recorded Transbay Vehicular Traffic And Future Estimates

Table 1 gives the official records of vehicular traffic on the San Francisco-Oakland Bay Bridge from 1940 through 1948. Also given are Coverdale and Colpitts estimates of bus traffic and total future revenue traffic through 1970, as prepared by them for the Division of San Francisco Bay Toll Crossings of the California State Department of Public Works.

Estimated Division of Future Trans-Bay Traffic Between Bay Bridge and Southern Crossing

Using a recent origin and destination survey as a base, Coverdale and Colpitts calculated the number of total trans-bay trips that would find it more convenient to use the Southern Crossing than to use the existing Bay Bridge. They determined that only 18 per cent of the trans-bay traffic would be better served by the Southern Crossing, with its approaches and connections as laid out by the Division of San Francisco Bay Toll Crossings. Modifications of the plans for the approaches would considerably alter this percentage division of the traffic. Certainly, if the Parallel Bridge were built, it is irrefutable that at least 18 per cent of the traffic would find the twin bridge *less* convenient, whereas the Southern Crossing, in conjunction with the Bay Bridge reconstructed to increase its capacity, would serve all traffic reasonably well.

The amount of new traffic that will be generated or induced by a new water crossing can only be estimated on the basis of wide experience of similar crossings. The Joint Army-Navy Board stated that in its judgment the induced traffic would be 10 per cent of the total trans-bay traffic. This 10 per cent figure, though less than has been experienced in many other cities with new crossings, was

***McHugh and McCrosky, Community and Regional Development Consultants, New York.**

TABLE I. RECORDED TRANSBAY VEHICULAR TRAFFIC AND FUTURE ESTIMATES
(All figures are in thousands of vehicles)

Year (A)	Passenger Cars (a) (B)	Trucks (b) (C)	Buses (cc) (D)	Trucks & Buses (E)	Total Revenue (cc) (F)	Non-Revenue (G)	Grand Total (H)
1940	14,058	713	256	969	15,027	237	15,264
1941	17,293	955	421	1,376	18,669	430	19,099
1942	17,401	1,129	644	1,773	19,174	1,397	19,571
1943	15,644	1,287	500	1,787	17,431	1,728	19,159
1944	14,711	1,398	515	1,913	16,624	2,001	18,625
1945	17,791	1,460	547	2,007	19,798	2,330	22,128
1946	21,846	1,562	613	2,175	24,021	1,333	25,354
1947	22,824	1,790	556	2,346	25,170	708	25,878
1948	23,051	1,906	516	2,422	25,473	737	26,210
1950	x	2,175	x	x	26,850	688	27,538
1955	27,689	2,740	674	3,414	30,429	775	31,204
1960	30,362	3,375	748	4,123	33,737	860	34,597
1970	34,839	3,870	858	4,728	38,709	986	39,695

(a) Includes Trailers, Motorcycles and Tricars.
(b) Estimated by the consultants to the Committee, for future years.
(cc) Coverdale and Colpitts, estimates for future years.
(x) No estimate available or prepared.

accepted by the consultants as a valid estimate for purposes of investigation and design.

After making appropriate adjustments based on improvements in the approaches to the Southern Crossing and other factors, and after adding the 10 per cent induced traffic allowance, the consultants reached the conclusion that the Southern Crossing may attract the following proportions of the future trans-bay traffic.

1956	27 to 30 per cent
1960	31 to 32 per cent
1970	32 to 33 per cent

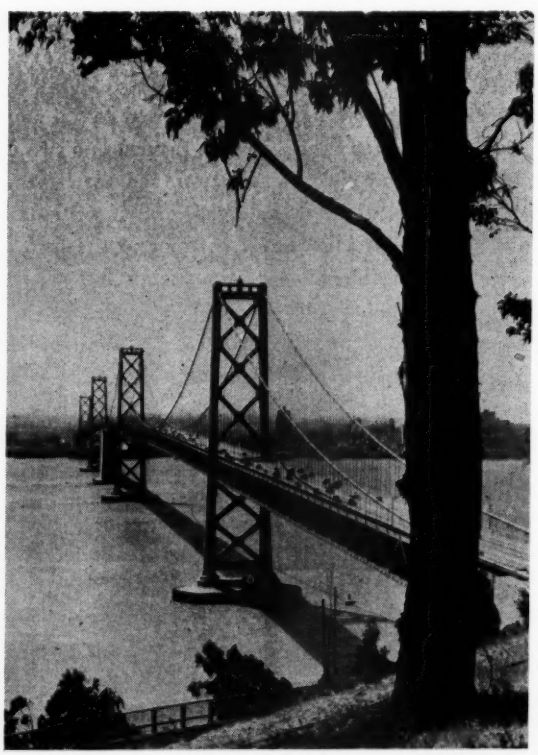
Existing San Francisco-Oakland Bridge

The existing trans-bay bridge accommodates at present six narrow lanes of passenger automobiles and light vehicles on the upper level, three in each direction, without any adequate separation between directions of flow. While the upper level sometimes carries as many as 4400 cars in a peak hour in one direction, a conservative capacity of the three lanes, not involving excessive loss of time due to congestion, may be assumed at 3600 cars. This corresponds to a total annual "comfortable" capacity of the six lanes on the upper level of about 22,000,000 cars, or approximately 1,000,000 less than were carried in 1948. The upper deck, therefore, may be assumed to have reached its desirable limit of capacity.

The present width of 9.7 feet per lane does not provide for adequate safety and efficiency. Furthermore, to avoid the danger of collisions, modern high-speed roads on bridges, as well as on the ground, are being provided with malls or islands separating adjacent lanes of opposite traffic direction. Turnouts for stalled cars are also a feature of good modern practice.

The lower level of the existing bridge now accommodates two tracks for interurban passenger trains and a single roadway of 31 feet width used ordinarily by trucks and buses only. For the greater part of the crossing's length, vehicular traffic flows on three lanes, 10.3 feet wide each, the middle lane being used by vehicles moving in both directions. This traffic arrangement is very dangerous and contrary to modern standards for high-speed roads.

As now operated, the effective capacity of the lower roadway is reduced to that of one lane in each direction, which is only about 5,500,000 vehicles per annum. Actually, the yearly volume of traffic on the lower level in 1948 was only 2,422,000 vehicles, or less than half of its present



—Screen Traveler, from Gendreau
San Francisco-Oakland Bay Bridge

capacity, and far below an efficient utilization of the space allocated to the lower roadway.

The two interurban passenger tracks on the lower deck were originally expected to carry an eventual 50,000,000 passengers per annum. No such figure has ever materialized. Even in the peak war year, 1945, only 26,469,000 were carried. The number of passengers and the revenue derived therefrom have been continuously falling off since 1945. In 1948, there were fewer than 16,000,000 passengers, or less than one-third the estimated capacity of the two tracks.

It is evident, therefore, that the traffic carrying and revenue producing capacity of the lower deck of the existing bridge is far from being utilized.

Proposed Parallel Bridge

The parallel bridge which the California Toll Bridge Authority proposes to build as a first step in the Public Works Department's plan for additional bay crossings, is planned to have the same deck arrangement, the same width of roadways, as well as the same provision to accommodate two tracks for heavy rail passenger traffic, as the existing bridge. The alternate of utilizing the space provided for the tracks for additional vehicular lanes is contemplated, but the bridge is to be designed to serve either purpose as needed. All traffic on the existing bridge is to flow east, and that on the new parallel bridge west.

Traffic on the upper decks of both bridges is to be reserved for passenger autos and light vehicles moving on five adjacent lanes of 11.6 feet width each. On the lower decks, without utilizing the space allocated to railway tracks, truck and bus traffic is to flow in two lanes, for which a more than ample width of 31 feet or 15½ feet per lane is provided. On both the upper and lower levels, the traffic safety would unquestionably be greatly improved. It may be questioned, however, as to whether the flow of traffic on the 5-lane upper deck roadways, without any separating strip, is adequately safe and effective.

Since the tracks on the existing bridge are now utilized to less than one-third capacity, and the traffic volume is falling off, the possible need of installing tracks in the corresponding space provided on the parallel bridge appears to be extremely remote.

Utilization of that space on the parallel bridge for vehicular traffic appears likewise questionable, unless the tracks are removed from the existing bridge. Otherwise, there would be four west-bound lanes on the lower deck of the new bridge and only two east-bound lanes on the existing bridge.

The full utilization of both bridges would create an enormous vehicular traffic capacity in the neighborhood of 60 million vehicles per annum, or far beyond the total volume that can reasonably be anticipated for the next forty years, or possibly even longer. It is also far beyond any volume that should be concentrated at one crossing and forced to pass through the congested area of the San Francisco business district.

If, as must be expected in view of the present situation, the space and extra carrying capacity of the bridge, which has been provided for the tracks and trains, are not utilized within the reasonably near future, then that provision would be a wasteful expenditure.

The construction of the parallel bridge, with its enormous traffic capacity as planned, would make it practically impossible for an indefinite time—possibly 30 years or more—to justify the financing and building of another crossing to serve the rapid expanding southern area.

Bay Area Rapid Transit Considerations

Consideration was given to various possibilities of reconstructing the existing bridge so as to bring about a more effective utilization of its traffic carrying capacity, and to improve its operating safety. An efficient modern rapid transit service across the bay, extending into and through the densely populated areas on both sides, would unquestionably increase trans-bay rail passenger traffic very substantially, and reduce vehicular traffic in buses and cars.

If and when an integrated Bay area rapid transit system is developed, the consultants concluded that it can be carried across the bay more advantageously and economically in tunnels than on the present bridge. This conclusion agrees with the recommendation of the Joint Army-Navy Board.

Increasing Vehicular Capacity and Traffic Safety on the Bay Bridge

Owing to the heavy equipment and concentration of load, the present interurban trains absorb a large part of the bridge's load-carrying capacity, which can be more economically utilized by the relatively light and well distributed motor vehicle traffic. If the tracks and trains were removed and replaced by buses, the required number of additional buses to carry the former train passengers would be about 215 in one direction in the peak hours. That represents less than one-fourth the hourly capacity of a single lane of vehicular traffic.

Compared to this small increase in volume of vehicular traffic, the removal of the tracks would permit the reconstruction of the lower deck to provide for a total of four lanes of vehicular traffic, two lanes in each direction, with ample width of the two roadways and an adequate safety island and turn-out bays between them. The effective vehicular capacity of the lower deck would thus be doubled, and the total annual comfortable capacity of the bridge for vehicular traffic would be increased from about 27 million to 33 million vehicles.

The traffic safety of the lower deck would be made equal to that of any modern high-speed highway. Mixed passenger automobile, truck, and bus traffic would, with these provisions, be entirely permissible, and the upper deck, which has already reached comfortable capacity, would be considerably relieved.

Somewhat more adequate street connections would have to be provided on the San Francisco side to accommodate the increased traffic on the lower deck, and the

train terminal would have to be converted for use by buses.

The removal of the tracks and the reconstruction of the lower deck can be accomplished without serious interference with present traffic over the bridge, and can be effected in considerably less time than building any other crossing. The resulting additional vehicular capacity would be sufficient until about 1957.

It was therefore recommended that the conversion of the interurban rail passenger service into bus or trackless trolley service be undertaken as a first step in a more comprehensive scheme for added vehicular facilities.

Owing to the great weight and heavy concentration of the interurban trains and the location of the tracks on one side near the main carrying parts—the cables and trusses—these tracks absorb a relatively large part of the load-carrying capacity of the bridge, and their removal would permit a further increase in the vehicular capacity of the upper deck. It was found to be entirely feasible to add four lanes for passenger automobiles and other light vehicles, two on each side, by building cantilever extensions of the upper deck outside the cables, trusses, towers, and anchorages, without increasing the design stresses of the present structure.

The entire upper deck would then form a modern eight-lane or dual-dual highway, affording maximum safety and providing sufficient extra space to accommodate stalled vehicles.

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Together with the proposed reconstruction of the lower deck, previously described, this addition to the upper deck would increase the capacity of the existing bridge to nearly 43 million vehicles per annum. It would thus add over 50 per cent to the comfortable vehicle capacity of the present bridge, besides providing greater safety, convenience, and speed. This increased volume represents, in the opinion of the consultants, the maximum vehicular traffic that should be concentrated at one crossing.

It is estimated that this reconstruction, together with the conversion of the lower deck from train to bus service and the provision of improved approaches, can be accomplished at about one-third the estimated cost of the proposed paralled bridge.

Reconstruction of the upper deck could not be accomplished without serious interference with traffic on that deck, and would have to await the completion of the recommended Southern Crossing, to which part of the traffic would be diverted during the construction period. Financing would appear to be feasible in 1955.

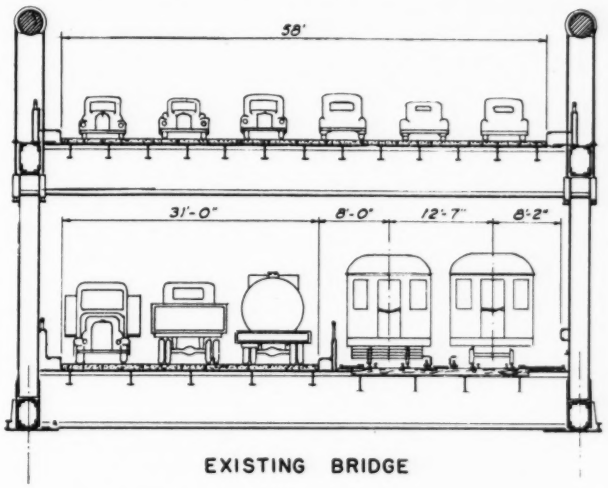
Southern Crossing

After studying many submitted plans, the Joint Army-Navy Board undertook preparation of their own plan for a southern crossing, which was published in their report of January 25, 1947, as their preferred solution of the trans-bay traffic problem. The water crossing was designed as a combination of causeways and trestles, with the main channel underpassed by three tunnels, each of two lanes, with a clear passage 1500 feet wide and 50 feet deep.

On November 10, 1947, the California Toll Bridge Authority adopted a recommendation of the Director of Public Works that *both* a parallel bridge *and* a southern crossing should be constructed. The Department's subsequent design and cost studies indicated clearly that the Parallel Bridge and the Southern Crossing could not be financed and constructed simultaneously on a revenue bond basis. It recommended that the Parallel Bridge, together with approaches on both sides of the bay, as described in its report of November 10, 1948, be built at the earliest practicable date; and that the construction of the Southern Crossing be deferred until it can be financed as a third bay crossing.

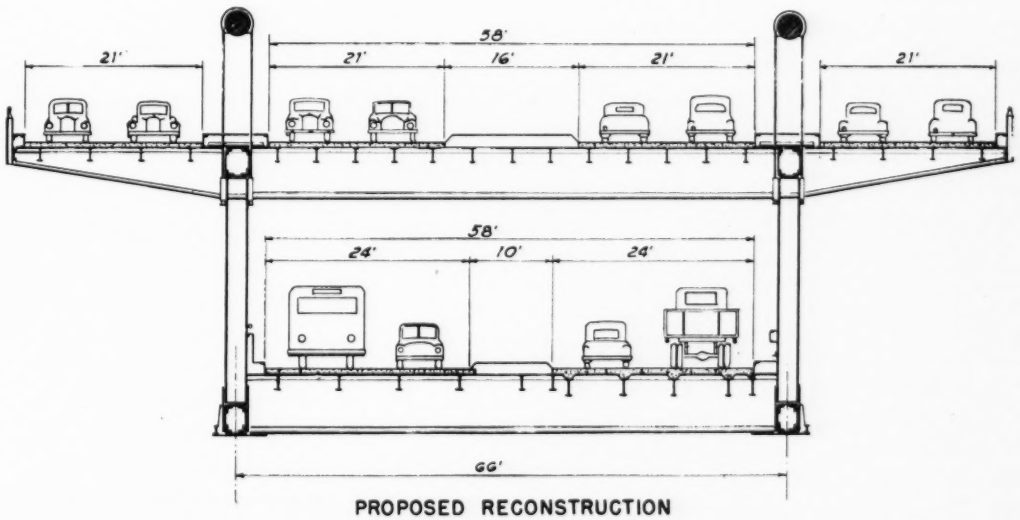
The Southern Crossing, as proposed by the Department of Public Works' Division of San Francisco Bay Toll Crossings, follows the general location and plan recommended by the Joint Army-Navy Board. The following principal modification of the plan was recommended to the legislative committee:

The Southern Crossing should be built as a causeway and tunnel with *four* lanes, two for traffic in each direc-direction. The origin and destination count, which was made subsequently to the Joint Army-Navy Board's studies, showed that a four-lane crossing at this location would adequately serve the traffic for many years to come. This change in plan, alone, would result in a saving in cost estimated at nearly $25,000,000. Other modifications of



EXISTING BRIDGE

Upper Deck - Passenger Cars and Light Vehicles.
Lower Deck - Trucks, Buses, and Interurban Trains.



PROPOSED RECONSTRUCTION
OF UPPER AND LOWER DECKS

Upper Deck - Passenger Cars and Light Vehicles.
Lower Deck - Trucks, Buses, and Passenger Cars.
Upper Deck Roadways may be made 22'-0" wide if desired without exceeding design stresses in existing bridge.

TYPICAL SECTIONS OF
SAN FRANCISCO OAKLAND BAY BRIDGE
SUSPENSION SPANS

SCALE IN FEET
0 5 10 15 20 25

JULY 18, 1949

layout and design, without sacrifice of efficiency, increase the total saving to approximately $30,000,000.

The recommended Southern Crossing, with four lanes of traffic, can be built in not to exceed four and one-half years construction time, preferably starting in 1951, with completion in 1955.

There are many factors tending to create a high traffic capacity per lane per hour on the recommended Southern Crossing, among which are the following:

There is in the Bay Area a small percentage, less than 10 per cent, of commercial traffic, that is buses and trucks. The alignment of the tunnel is straight. The immediate approaches to the tunnels are level causeways free from cross traffic or traffic lights and with unobstructed view of the road ahead. The ruling grades are kept at 3½ per cent. The roadways are wide, with adequate illumination, and are provided with intensive lighting at the entrance portals. On the causeway approaches to the tunnels, turn-out bays are recommended for disabled vehicles every 500 feet on each side.

Based upon these considerations and upon tunnel operating experience, it is estimated that the comfortable peak hour capacity of one of the two-lane one-way tunnel roadways would be 2350 vehicles per hour.

If the Southern Crossing should attain the maximum estimate of 33 per cent of trans-bay traffic, it might reach its comfortable capacity of 14,300,000 vehicles per annum by 1970 or shortly thereafter. Even on this extreme basis, its actual maximum carrying capacity would not be attained before 1980.

It would be unnecessary and unwise to spend at this time the added amount of nearly 25 million dollars to build a six-lane crossing, when the additional capacity will not be needed for 30 years or more. It is reasonable to assume that when the time comes, additional facilities can then be more advantageously planned and built to fit the conditions that will exist in 1980 or thereafter. At that time it may be found better to construct a third crossing at a different location.

Approaches to Southern Crossing

Had the Southern Crossing been designed by the Division of San Francisco Bay Toll Crossings on the premise that it would be constructed next, and that the Parallel Bridge might never be constructed, then an entirely different concept of approaches might very logically have been evolved. The whole question of approaches therefore merited thorough re-analysis, to make sure that the crossing will be of maximum convenience to the maximum

(See SAN FRANCISCO BAY, *page 36*)

TABLE II. CAPACITIES OF RECOMMENDED BAY CROSSINGS AND FUTURE ESTIMATED TRAFFIC VOLUMES

Bay Crossing	Estimated Year for Completion	Comfortable Capacity of each Facility		Combined Comfortable Capacity of Facilities When Completed		Estimated Transbay Traffic (a)	
		Peak Hour one way	Annual	Peak Hour one way	Annual	Year	Annual Volume
Present Bay Bridge							
Upper Deck		3600	21,600,000				
Lower Deck		900	5,400,000				
		4500	27,000,000	4500	27,000,000	1950	27,538,000
Bay Bridge with Reconstructed Lower Deck							
Upper Deck		3600	21,600,000				
Lower Deck	1952	2000	11,400,000				
		5600	33,000,000	5600	33,000,000	1957	32,800,000 (c)
Southern Crossing							
Four Lanes	1955	2350	14,300,000	7950	47,300,000 (b)	1978	47,300,000
Bay Bridge with Both Decks Reconsctructed							
Upper Deck	1958	5200	31,200,000				
Lower Deck		2000	11,400,000				
		7200	42,600,000	9550	56,900,000	After 2000	55,000,000

(a) Based on projection of Coverdale Colpitts figures, with 3 per cent allowance for non-revenue vehicles and 10 per cent allowance for induced traffic on Southern Crossing. Includes buses to replace rapid transit trains, after 1950.

(b) If the Southern Crossing achieves 33 per cent of total transbay traffic, it might reach its "comfortable" capacity by 1970. However, it should not become congested before 1980.

(c) Excluding induced traffic on Southern Crossing.

Highway Planning Symposium

PART III

by F. H. FLOYD*

Ed. Note: This is the third and last in a series of three papers presented before the Washington Section, ITE, at its January 1949 meeting. The first discussion on the financial and economic aspects, by Yule Fisher, appeared on page 272 of the March issue. Dean J. Locke presented the transit viewpoint on page 525 of the August issue. Mr. Floyd herewith discusses the trucker's side of urban planning as it relates to the desires and needs of various types of intra-city transportation.

I AM most happy to have this opportunity to briefly discuss a subject, which, like Topsy, "just growed up"—and which is costing every one of us untold dollars annually. As I will shortly illustrate—the old law of averages digs right into your pay check and mine every time we buy something because of our city traffic problems.

First of all—let us consider the fact that everything we eat, wear or use comes all or part of the way by truck! By the best figures we have available, more than 300,000 trucks are operating within our cities today in some type of public transportation service; and trucks engaged in private carriage far exceed this number! However, the private carrier is generally in a more favored spot than we, because he can plan for suitable dock or parking facilities for his vehicles. He can control, to a large extent, the time, quantity and sorting or placing of his goods so as to avoid interference with other traffic to a very large extent.

But the motor carrier engaging in a public transportation service, particularly the local cartage common carriers, are faced with an entirely different situation. For example, those carriers who perform what is generally referred to as 'Pickup and Delivery Service' for railroads, over-the-road truck lines and carloading companies, must handle twice as much LCL or LTL business as all these line haul carriers because we handle it twice—once when the shipment originates and once when it is delivered. At no time can we tell where a shipment will originate or be delivered, with the few exceptions of large shippers who originate or receive a large volume daily.

The Double Parking Problem

A glance at any downtown or other principal business street of any of our cities will show hundreds and thousands of small business houses, all potential small shippers, occupying places located on streets built when only a few horse-drawn vehicles used those streets, where goods are taken in through, or out of, holes in the sidewalks or front doors. Assume such a business house receives a box weighing 100 pounds—which is relatively small. The curbing is filled with private automobiles. If we are lucky we may find a truck loading zone at the far end of the block. How are we to accomplish that delivery? Double parking most generally results. In somewhat of a recent survey it was found that of the 48 cities reporting, 31 did not permit double parking. Maybe we must violate the law while we double park since that is the only course open to us.

While we most certainly would not advocate double parking as a solution to this problem, let us look at the probable cost of our inability to make such deliveries quickly. In St. Louis it is estimated that an average truck costs from *5 to 8 cents per minute*, while making deliveries; in New York 5 to 7½ cents per minute. Just count the cost of a 20 minute delay driving around the block looking for a place to stop—or perhaps a half hour consumed in making a small delivery of that gadget your wife ordered. You can easily see from $2 to $3 added (and maybe the same thing happened at the other end of the line) so the cost has doubled from $2 to $3 to $4 to $6! Don't console yourself with the thought that the price to you was fixed and, therefore, no concern of yours— *That same thing happened yesterday, and the day before* and that amount was already added to the price. So the problem comes home to you by the law of averages.

Consolidating Shipments

But it may be argued, why not consolidate such shipments so that fewer trucks will be required to handle this city service? First—as to the railroads, carloading companies, and the large over-the-road truck lines who perform their pick-up and delivery service by their own vehicles as individual contractors. Generally, these agencies have a large volume of business coming into and going out of their terminals so that their city delivery trucks operating into some areas are fully loaded; that is, they operate on the diminishing load principle—starting out with a full load and unloading as they progress along a given route. Conversely, they return to the terminal fully loaded with outbound shipping. Further con-

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solidation would eliminate few of these vehicles operating in heavy receiving or shipping areas. But such consilidations would undoubtedly greatly reduce the number of city trucks used by the smaller over-the-road truck lines, where some consolidations might be urged. One such project is now being developed in New York City by the Port of New York Authority and may furnish some very valuable experience for further activity. Where these projects have been attempted in the past they have generally ended in dismal failures, largely because the over-the-road truck lines, as a general rule, would only use such consolidated facilities for the handling of their non-profit business; so that local cartage carriers soon refused to handle this business even though it could have been very successfully consolidated with other business. Local cartage operators many times cover certain routes or areas daily and either deliver or pick up shipments for distribution locally or going to other line haul carriers. *We are in a position to extend that service and thereby greatly reduce the number of trucks in our congested areas.*

Loading Zones vs. Time Restrictions

Why establish adequate truck loading zones in preference to restricting daytime deliveries? Let's not forget what happens when we kill the goose that lays the golden egg. It's amazing to hear learned men say "Curb parking and *truck loading facilities* in most urban areas are greatly inadequate and therefore becoming subject to increasingly more stringent regulations. As the demand for street space for movement increases, curb parking *and loading* must continue to wither away and in the larger centers will *become outlawed!* Of what use is such area if no food or materials are moved in or out? Curb space for private automobiles may and will be restricted—but can you imagine outlawing public transportation? Let's again remember—everything we wear, eat, or use comes all or part of the way by truck! Fortunately, another authority who knew the situation better says—"Autos and trucks are an integral part of every city's transportation system."

From time to time we hear of ordinances and proposals to restrict truck deliveries to night time or to other times when Mr. Common Citizen would not have his pleasure of driving about the city rudely disturbed by some truck, which incidentally had probably only yesterday delivered that new cocktail shaker he was now driving over some 15 miles *of busy city streets* to purchase. We must fight these constant threats in order to continue to serve our cities in the most economical way.

One of the best illustrations of why deliveries at specified hours will not work (for the time at least) was the recent trial in New York City, where congestion is probably worse than at any other place in the country. Mr. Common Citizen, whom we have just mentioned, or any of the thousands of small businessmen of New York City, only received a few shipments per week, month or year. His *one* shipment arrives at 7:00 P.M. on the day he has succeeded in enacting an ordinance or traffic regulation which forced us to deliver it at night. Lo and behold!—he is not at his place of business to receive his shipment but at home enjoying dinner with his family and guests. Will he come down to receive his shipment? Not him! His day is over. Will he stand the expense of keeping a night man constantly on the job when his shipments only come in infrequently? He will not! And that is exactly why the New York trial ended in failure and will fail anywhere it is tried. Economically such plans are unsound, at least for the present. The *shippers* killed the New York plan—not the trucking companies!

Solutions For The Trucking Problem

You have probably heard of the old axiom that lawyers resort to when they are back of the eight ball—'to shout and thump the table'—well, I've shouted my time away because I am back of the eight ball without the answer to our common problem. We are trying to find a means of forcing a six-inch stream of water through a two-inch pipe; therefore, one of three things would seem necessary: (1) either the street facilities be increased; or (2) the volume of traffic be reduced through decentralization; or (3) there be an appreciable step-up in the speed of traffic. This last alternative has very definite limitations because of the safety factor. To increase our street facilities we must work with streets that have been handed down to us and which never were intended to handle our present traffic; and on top of that, on which we will find shipping and receiving facilities just as outmoded. Obviously with high property values in our urban centers we cannot rebuild or relocate streets as we do with highways of the countryside.

One-way streets seem to be a must and merchants and property owners must be convinced, perhaps forcibly in some cases, that streets are provided for the flow of traffic and not as parking lots in our congested areas. Truck loading facilities must be provided if our transportation system is to function economicaly because one truck losing half of its time in a congested area means two trucks in the same area. We have no choice! As common carriers we must pick up or deliver shipments when consigned to us, and the more obstacles in our way, the greater the cost to you, the consumer.

Off-street parking must, and will be developed, not only in the congested areas, but at outlying points with ready access to shoppers through the facilities of the local transit company. I feel sure that our merchants will quickly find that 'friend wife' will be delighted to be able to quickly and easily park at some accessible point. be whisked quickly and reasonably by bus to the store she has chosen in preference to hunting all over the shopping district for a parking space, paying a high park-

(See HIGHWAY PLANNING, *page 37)*

Ohio Pavement Striping Equipment

by HARRY E. NEAL *(Mem., ITE)**

THE techniques of mechanization and mass production —trademarks of American enterprise and progress— are being applied in the State of Ohio and other States to the business of pavement striping state highways.

Based on experience acquired in painting center lines and lane lines over a period of several years, the Division of Traffic and Safety, Ohio Department of Highways, has developed motorized stripers capable of laying pavement markings at 10 to 12 miles per hour in contrast to less than 3 miles per day laid by the earlier walk-type stripers. As much as 75 miles of line per 8-hour day can be applied by one of these stripers. The amount of line applied per day on the average is limited to a considerable extent, however, by the difficulties encountered in keeping vehicles from crossing and tracking wet lines.

A General View of the Ohio Pavement Striper and House Trailer for Crew.

The first striper used by the Ohio Department of Highways was introduced in 1924, when less than 100 miles of centerline needed to be applied on state highways. Now, over 10,000 miles of line are painted annually.

Early striping was done by small machines, some self-powered, but guided and serviced by an operator on foot, thus limiting the speed and range to the distance a man could walk and push a striping machine in a day.

In 1939, the State of Ohio adopted the standard system of the American Association of State Highway Officials for marking no-passing zones.[1] In this system, a yellow no-passing or "barrier" line parallel to and on the right of the white center line indicates where overtaking and passing is unsafe because of limited sight distance.

With the walk-type machines, separate operations were required for the applications of the centerline and for each yellow line. It was obvious that this was not only too costly but also too slow. An experimental motorized striper was built and placed in operation in June 1940. The machine was shop-assembled from standard parts and mounted on a 1½-ton chassis.

Experience with this machine indicated that a number of changes were desirable and the original unit was dismantled and rebuilt on a heavier truck. In addition, three new units similar to the rebuilt one were constructed on three-ton cab-over-engine chassis with wheelbases of 99 inches.

In 1949, two more units, making a total of six stripers, were put into operation. These two new units were built on five-ton chassis with 105-inch wheelbases.

Each of the six stripers has a two-compartment tank with a total capacity of 700 gallons—450 gallons for white paint and 250 gallons for yellow. Each compartment has a vertical shaft two-blade agitator, driven by air motor, and a manhole of 20 inch diameter to facilitate cleaning the tank when necessary.

All operating controls for the paint spray equipment are mounted at the rear of the striper so as to be immediately in front of the spray operator. The air-regulator manifold is a special type having the regulators integral with the manifold.

Experience with the first truck-mounted striper, built in 1940, indicated that it is desirable to provide means for lateral movement of the spray guns to enable the operator to compensate for deviations by the driver from the correct path, particularly on curves. To provide the desired lateral flexibility the spray guns are mounted on a dolly riding on two 16-inch pneumatic-tired wheels. The dolly is attached to a standard trailer-hitch ball bolted to a plate

***Chief Engineer, Division of Traffic and Safety, Ohio Department of Highways.**

[1] *A Policy on Criteria for Marking and Signing No-Passing Zones on Two and Three Lane Roads—AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS.*

Rear View of Ohio Department of Highways Pavement Striper.

that slides in guides attached to the differential housing of the truck. This arrangement permits the spray gun trailer to be moved a maximum of four inches to the right or to the left of normal position. Control of this movement is by means of a conventional automobile steering wheel and column, Pitman-arm and drag-link.

An air lift is used to raise the dolly when the truck is in transit or to lower it to the road surface for operation. Safety chains support the dolly in a raised position.

A platform suspended from the rear of the truck carries guards that are placed in the freshly painted lines to protect them when wet. Supported from this platform are two motorcycle saddles, one for the spray operator and one for the man who places the guards on the lines. Each saddle is about eight inches above the pavement. The exhaust from the truck motor and the compressor is discharged through vertical stacks so that the gasses do not affect the operators working at the rear of the truck.

Three internal-atomizing spray guns of standard make, mounted side by side on the spray gun carriage, app'y the pavement markings. Three levers for operating the paint gun control valves are located to the right of the operator's position. The width of the line applied by each gun is controlled by two floating steel plates or shields, which move verticaly on fixed guides, on four of the stripers which have 60 cu. in. per minute air compressors. On the two late model stripers, which have 105 cu. in. compressors, air curtains are used instead of the metal guides.

The stripers can apply two colors and three lines simultaneously where passing is restricted in each direction.

A tracer wheel on the front end of a modified A-frame assembly, made of one-inch boiler tubing electrically welded, is used for guiding the driver on a line to be retraced or on a pre-spotted new line. This guide has a total length of about 10 feet, including the airplane tailwheel fork assembly on the front. The wheel on the front, with a 3.00x10x10 tire, is employed as the tracer wheel. This unit, mounted well ahead of the cab-over-engine, can be readily seen and followed by the striper driver.

The guide assembly frame is made in two parts so that the assembly can be taken apart and folded up against a supporting structure on the front of the truck when in transit. The rear section of the frame is attached to the bumper of the truck by a shaft in journal fittings.

The steering guide and the spray gun carriage are situated so that the striper, when in operation, straddles the centerline or lane lines being painted. This allows overtaking vehicles to pass on the right, eliminating the need for crossing the wet line or lines to pass on the left. A large sign on top of the striper body and another sign on the rear platform instruct overtaking vehicles to pass on the right.

An oscillating blinker light to warn approaching traffic is mounted on top of the striper cab. Additional warning to traffic is given by three red flashers, two in front and one in the rear. The striper is equipped also with a siren for use when necessary.

When the truck is moving, communication between the driver and the spray gun operator is established through a two-direction inter-communication system, with microphone-speaker in the cab and combination of trumpet and microphone-speaker in the rear.

In painting its state highways, Ohio uses solid center lines and lane lines 4 inches in width, and 4 inch yellow

(See OHIO PAVEMENT, *page 37)*

Front View of Ohio Department of Highways Pavement Striper.

Facilitating Traffic Flow With One-Way Streets

by KARL A. BEVINS *(Mem., ITE)**

Ed. Note: This paper was delivered by Mr. Bevins at one of the Traffic Engineering Sessions of the Southern Safety Conference, held at Tampa, Florida, earlier this year.

IT IS AN accepted fact that problems of traffic accidents and congestion have been with us for many years. However, it has been only since the end of the recent war that inefficiencies in our transportation system reached such proportions within our business districts and along the main arteries leading to these concentrated areas of activity that this particular problem of urban development received the attention which its great importance merited.

In this post-war era, traffic accidents and congestion have increased at an accelerated rate for a number of reasons. *First*, traffic volumes have continued to increase owing to the great production of new motor vehicles and the greater use of all motor vehicles. *Second*, the high level of prosperity and business activity has attracted larger numbers of persons into the concentrated centers of trade. *Third*, the lack of adequate parking facilities has made it impossible for these areas to properly absorb the large numbers of entering vehicles. *Finally*, the construction of urban expressways terminating near central business districts bring more vehicles to the congested areas at greater speeds and in such concentrations that they cannot be efficiently distributed by existing street systems.

Among the many "tools" at our disposal to aid in coping with this difficult situation is the one-way street. One-way streets *properly used* can literally work wonders in many of our cities with little or no change in the existing street systems.

For the motorist they provide greater street capacity, increased speeds and reductions in accidents and congestion. Some inconvenience, annoyance, added travel distance and the need for trip planning also accompany their use.

For the business man, they guarantee increased volumes of business by improving the accessibility of and reducing congestion within the business district. Certain applications may temporarily or permanently affect adversely some types of business, such as filling stations, grocery stores, drug stores and restaurants which are located along arteries leading *into* the business district. They have no bad effects on business within the area because a majority of the shoppers enter the district in some form of mass transportation and those who arrive by private automobile expect to walk some distance after parking.

For a city government, they permit elected officials to provide improved motor vehicle operation within the limitations of existing facilities at a minimum of cost. Improved accessibility and reduced congestion help maintain the integrity of a business district by reducing the threat of decentralization which in turn stabilizes property values and insures a maximum tax return from that concentrated section of the urban area which pays the largest portion of the tax burden.

It is evident that the use of one-way streets can become a powerful ally in our efforts to reduce accidents and congestion. However, with all of their advantages they also bring some very dangerous disadvantages and unless they are used wisely and applied in only those situations which warrant their use, they can cause serious damage. It is with these facts in mind that the following discussion of the advantages and disadvantages of one-way streets was prepared, together with some examples of good applications.

Advantages

1. *Reduces conflicts between lanes.* One-way streets eliminate the head-on conflict between opposing streams of traffic. Accidents are thereby reduced, particularly the head-on collision type which is usually severe. The driver is relieved of the fear of head-on collisions which leaves him more freedom to guard against other types of accidents. Headlight glare, with its hazards, is eliminated. The removal of this head-on conflict results in a smoother and faster flow of traffic.

On streets of 40 feet width or less, the conflict between the parking lane on the right-hand side of the street and the next moving lane is lessened if the street is one-way. The driver feels, and actually is, more free to swing to his left in case a pedestrian steps out from behind a parked auto or one of the parked vehicles pulls out into his path.

2. *Reduces conflicts at intersections.* At the intersection of two two-way streets there are some 24 points of conflict between streams of traffic using the intersection. At the intersection of two one-way streets there are only

*Traffic Engineer, Georgia Power Company, Atlanta, Georgia.

three points of conflict. For example, the difficulties caused by left turns from a two-way street are eliminated as far as vehicular traffic conflicts are concerned. The left turn still interferes with pedestrian movement but the driver is more free to watch for pedestrians and therefore the chance of accident is greatly reduced.

Congestion is greatly reduced because the left turning traffic can turn from the left-hand lane and permit straight through traffic to continue on through the intersection. There is no delay due to opposing traffic and the pedestrian-vehicle conflict is reduced in the crosswalk which the left turning traffic is crossing because there is no right-turning traffic from the opposite direction.

Traffic turning right from a one-way street can do so from the right-hand lane and not delay straight through traffic. This right turning traffic is not bothered by left turns from the opposing direction and is therefore much more free to watch for pedestrians in the crosswalk which it must cross.

3. *Increases capacity of street.* One-way streets usually attract traffic from nearby two-way streets. Due to the extra freedom of movement and the reduction of conflicts at intersections, one-way streets can accommodate a larger volume of traffic than the same streets operated as two-way streets.

Streets with an odd number of lanes, or of 30, 50 or 70 feet width can be marked with one more lane than if they were two-way streets.

Very narrow streets, one, two or three lanes in width, carry very little traffic when operated as two-way streets due to stopping, parking and turns at intersections. However, these same narrow streets when made one-way, will carry large volumes of traffic.

Even a four-lane street has more capacity as a one-way street because of reduced congestion at intersections. Wider streets have the same advantages when used as one-way streets but to a lesser degree.

4. *Simplifies parking problem.* The use of one-way streets sometimes makes it possible to postpone the removal of curb parking. There are numerous examples of cases where it was possible to make a street one-way and remove the parking from only one side instead of both sides as would have been necessary had it remained a two-way street.

Many narrow streets of two and three-lane widths can be made one-way and parking on one side retained for auto or truck loading without seriously hampering the street's ability to carry a sizeable traffic load. These same streets would be of little or no value for moving traffic if they were two-way streets.

The danger of sideswipe accidents so prevalent on narrow streets is greatly reduced when the street is operated as a one-way street.

5. *Simplifies traffic signal timing.* Progressive traffic signal timing becomes simple on one-way streets even though it is sometimes impossible on the same streets when they are two-way. The smoother flow of traffic which results from a good progressive system is conducive to

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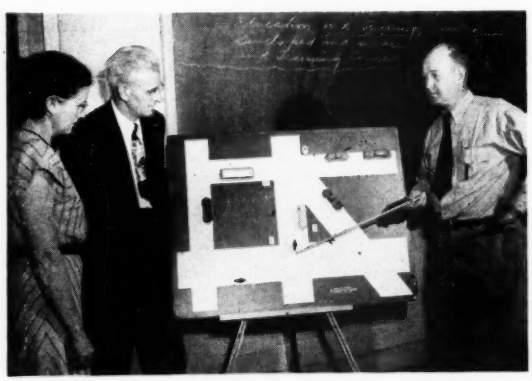

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safe conditions. Sudden stops and starts are reduced and speeding can be made nearly impossible.

6. *Aids pedestrians.* When crossing a one-way street the pedestrian has only to watch traffic from one direction. Due to the greatly reduced number of turning movements at intersections when one or both of the streets are one-way, there is much less interference with pedestrians when they are in the crosswalk. The traffic which is seeking to cross the crosswalk which the pedestrian is using is not as hard pressed for time because traffic behind is only slightly, if at all, delayed. This usually results in the pedestrian getting a much better opportunity to cross and cross safely. All of this spells safer conditions for pedestrians at the intersection when the streets are one-way.

7. *Simplifies complex intersections.* Frequently, it is possible to simplify the traffic pattern at an intersection. A situation which would require a three phase traffic signal with two-way streets can sometimes be made to operate very well with only two phase signals, by making one of the streets one-way, away from the intersection.

8. *Increases average speeds.* The above advantages make it plain that average speeds for vehicular traffic on one-way streets could be and are higher than on the same streets as two-way streets. Average speeds are frequently doubled as the result of a change from two-way to one-way.

9. *Reduces Accidents.* Accidents are reduced when streets are changed from two-way operation to one-way operation. Reductions of from 24% to 70% are common.

Disadvantages

1. *Increases driving distance.* One-way streets, especially a system of one-way streets, usually results in many more drivers having to go around the block to get to their destination. This, in effect, increases the amount of travel on the streets in the area. Unless carefully planned, this extra distance could become serious for certain types of business.

2. *Increases turns.* Due to the cruising around the block made necessary by a one-way system, there are nearly always more turns than there would be if the same streets were two-way.

3. *Confusing to strangers.* One-way streets are usually a little confusing to strangers and sometimes even to native drivers. This confusion is likely to breed accidents and congestion and unless the street system is a simple grid pattern, this confusion could easily offset otherwise good advantages.

4. *Usually must be considered in pairs.* When a street is made one-way it must usually have a mate to carry the return flow of traffic and this mate usually must be an adjacent street. This makes the use of one-way streets difficult unless a clean-cut grid street pattern is available.

5. *Reduces the capacity of the street system for transit.* It is usually better for transit vehicles to move along a street in a single lane, due to the frequency of stops to load and discharge. A system of streets with eight north-south streets would then have eight lanes for transit in each direction as two-way streets and only four lanes if they were made one-way streets. If the eight lanes operated at or near capacity under the two-way plan, then the four lanes which remained under a one-way plan would not be sufficient to accommodate the mass transportation and would therefore create a very serious situation. This is a disadvantage which is frequently overlooked in one-way street plans.

6. *Diverts traffic.* The changes in travel habits made necessary by one-way streets are the result of transit routes which must operate on two streets downtown instead of one, as they would on two-way streets; auto and truck routes which must wind around the block; and just plain confusion.

It has been found that grocery stores, filling stations, drug stores and various other "service" stores sometimes lose a small amount of business if they are located on one-way streets leading *into* the business district. Much of this type of business from commuter traffic is carried on in the afternoon on the way home from town. Therefore it may be inconvenient or difficult to circle back to the inbound street just to make a small purchase.

7. *Reduces right-turn capacity.* The number of streets from which traffic may turn right is cut in half when a group of two-way streets are changed to one-way streets.

8. *Requires additional sign posting and enforcement.* One-way regulations invariably require many signs and therefore stepped-up enforcement to see that the signs are obeyed properly.

The following examples of ways in which one-way streets have been used to facilitate traffic flow were selected to illustrate some of the many possibilities:

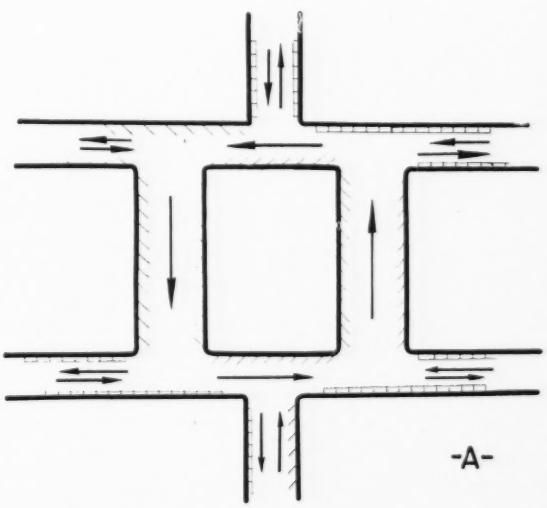


EXHIBIT A. *Courthouse square:* Changing this square from two-way to one-way operation as shown in the illustration, with traffic flowing in a counter-clockwise direction, cleared up most of the congestion and enabled the merchants to retain angle parking.

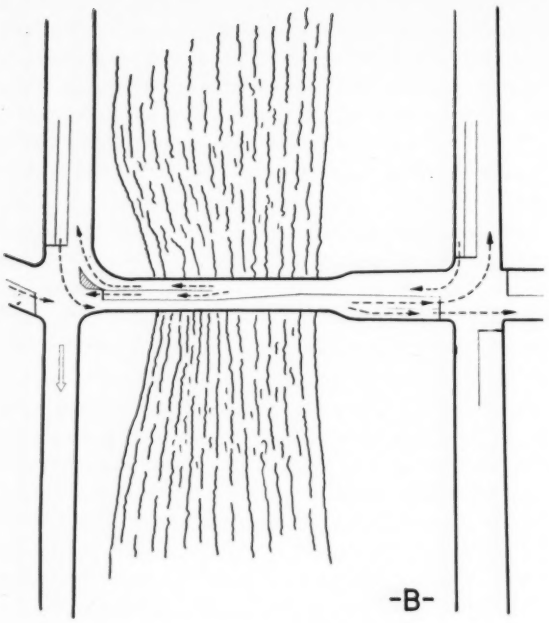


EXHIBIT B. *River Bridge:* A heavy left-turn onto the bridge from the west was aided by eliminating a minor entering movement through the one-way regulation. The heavy right-turn off of the bridge at the west end was aided by the one-way regulation which permitted the installation of a channelizing island.

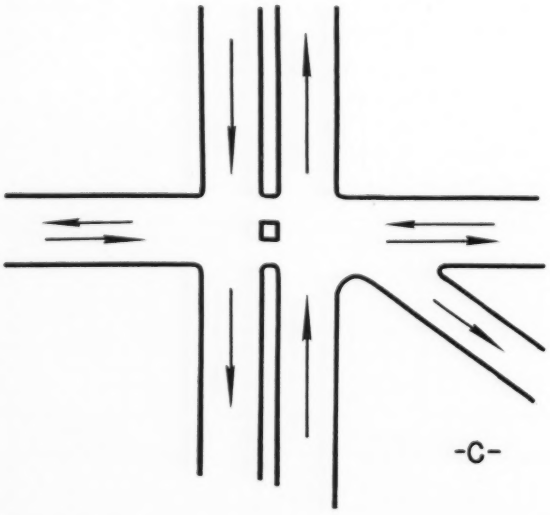


EXHIBIT C. *Multiple Intersection:* This heavily traveled downtown intersection was changed from a three phase signal operation to a two phase operation by the one-way street taking traffic away from the intersection.

EXHIBIT D. *Downtown Section:* Poplar, Williams and Fairlie Streets are examples of very narrow (two-lane) streets that have been made one-way with truck loading and unloading permitted on one side between 9:00 A.M. and 4:00 P.M. As two-way streets, they were always congested. As one-way streets, they serve a very useful purpose for moving traffic as well as removing many loading operations from adjacent main streets.

Alexander Street and Mills Street are a pair of two-lane streets which were made one-way with parking permitted on one side. They serve now as a valuable crosstown bypass route and take a heavy load from main streets.

Porter Place is a single one-way street with no mate. It serves as a crosstown connector from West Peachtree Street to Ivy Street and carries a very heavy load which would otherwise clog the downtown streets.

Baker Street, Harris Street, Cain Street, Ellis Street are a series of crosstown streets which, since being made one-way, have permitted more "green" signal time to be assigned to Peachtree Street and Spring Street. Because of their increased capacity as one-way streets they required less "green" or "go" time to clear traffic using them.

Gilmer Street was made one-way for one block from Edgewood to Courtland to permit heavy left-turn traffic outbound on Edgewood to go Edgewood, Gilmer to Courtland, instead of Edgewood to Courtland.

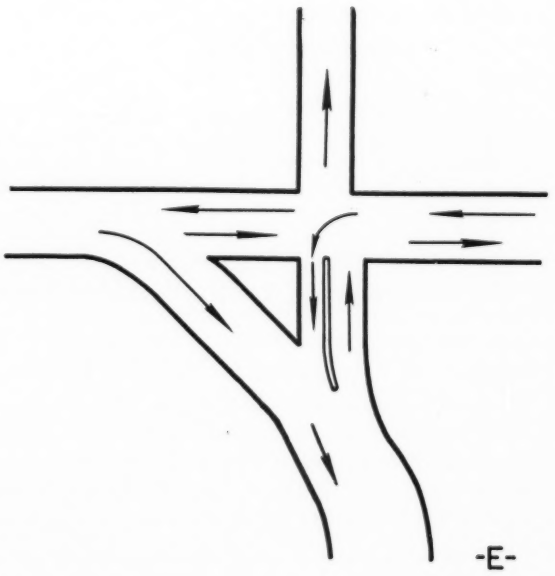
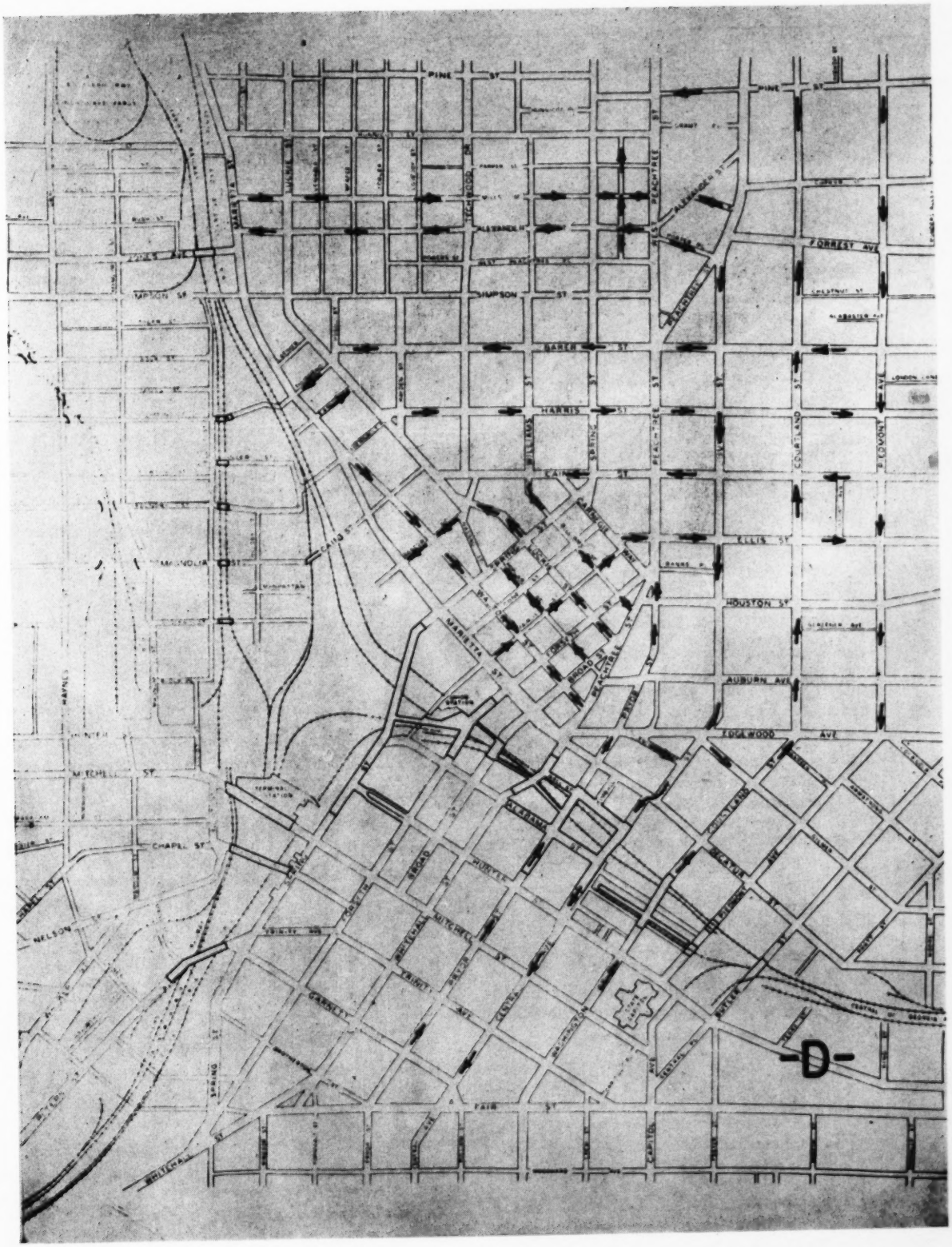


EXHIBIT E. *Heavy Left-Turn:* What was formerly an excessively heavy left-turn was coaxed on


PINE ST
FORREST AVE
HARRIS ST
HOUSTON ST
AUBURN AVE
EDGEWOOD AVE
MARIETTA ST
MITCHELL ST
CHAPEL ST
FAIR ST
-D-

straight through the intersection by the one-way street leading away from the intersection. This distributed the left turns over two intersections instead of only one and removed interference to the left-turns from an opposing traffic stream.

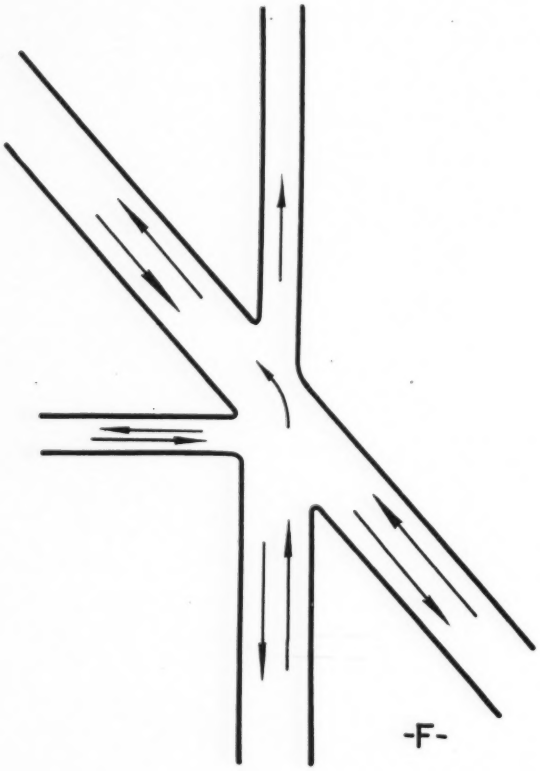
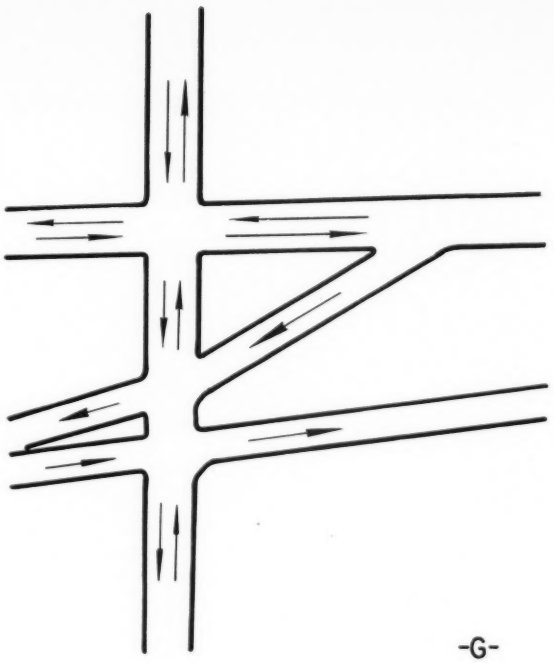


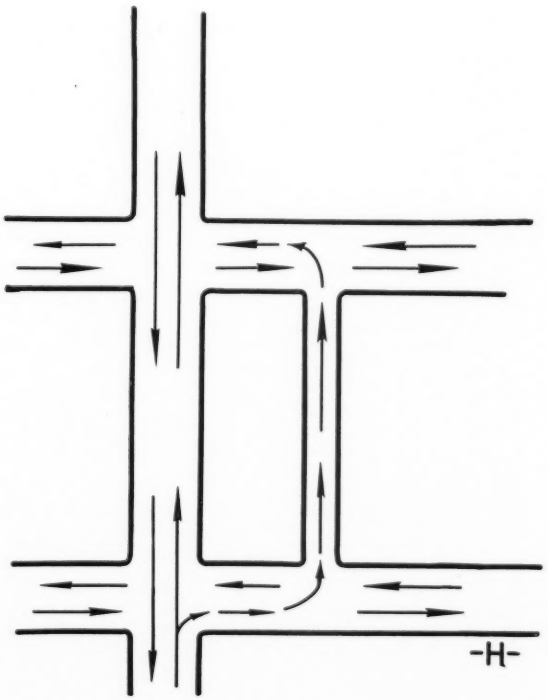
EXHIBIT F. *Heavy Left-Turn:* This minor approach to the intersection was made one-way to remove all interference to the left turns.

EXHIBIT G. *Narrow Street:* A narrow (two-lane) street was made useful by converting an old street car right-of-way to another narrow street and making a pair of one-way streets to form a connector cut-off between two intersecting thoroughfares.

EXHIBIT H. *Heavy left-turn through an alley:* Traffic was heavy in both directions on the street from which the left-turn was made. The conflict was eliminated by having left-turning traffic turn right one block early into a lightly traveled street and then left into an eighteen-foot alley (in two lanes) and out into the street which it wishes to reach.

The advantages and disadvantages just discussed, together with the few examples of ways in which one-way streets have been used to facilitate traffic flow, indicate





the wide, and as yet, only little used application of one-way streets. It is believed that as a logical conclusion we may say that only a few cities have used one-way streets to the fullest possible advantage and that almost every city will find some use for them in facilitating the flow of the rapidly growing post-war traffic.

Ten Steps in Research

by M. EARL CAMPBELL *(Mem., ITE)**

Ed. Note: This paper was presented to the students at the Yale Bureau of Highway Traffic last May. In view of the fact that we are beginning a series of articles this month, based on student research for thesis requirements, we believe this paper is quite timely.

THOUGH research is still more of an art than a science, nevertheless certain steps taken in the right sequence and in the right direction will expedite the solution to research problems. To secure a more orderly and systematic approach ten steps have been used by many successful researchers.

Step One—Selection of Research Projects

The first step, and perhaps the most important in terms of final achievement is the selection of a project, or program. This step merits as careful planning as the other nine steps. We assume that you will be concerned with the selection of projects, if you are to be responsible for carrying out the research.

Projects usually rise out of our problem experiences if we are sensitive to them—or in other words, if we are problem conscious. This sensitivity comes from a curious, or diagnostic, or critical mind, and leads to close observation in the field of our professional calling and experience for projects. Projects may come as desire for change arising from imperfection, inefficiency, deficiency, difficulty, failure, accident, instability, expense, discomfort, etc.

Projects may arise out of the desire to know more about the characteristics of certain behavior or operations, and how changes in stimulus affects these characteristics. This desire may stem from curiosity, and the project thus suggested may be one in pure research, but it has a good chance to result in applied research.

Projects crystallize out of our needs and desires, and are recognized by observance of changes, or need for change, or need for better adaptation to the existing condition. Beyond our own limited area of experience we can reach out to grasp the problems coming from the experiences of others. Close at hand we may note controversies and frictions growing out of differences in individual judgments. At the root of the matter may be a research project.

Interviews with others in the same or related profession may lead to projects stemming from their professional experience. Statements expressed as opinions may offer a suggestion for a project. Questions raised and unanswered offers a fertile field for the project seeker.

There are yet other sources for projects to those whose own experience has been limited. Problem listings have been made by research institutions which may be made available in some cases through the proper approach.

As a final source suggestion public opinion polls are sometimes helpful in indicating the desires of the public for new creations and improvement.

After a tentative selection test the project for justification. What is the magnitude, frequency, and extensiveness of the problem? What is the purpose of the project? Will it be more worthwhile to devote time, energy and money to solving this problem than to have spent it on another? Can the results be applied? Does it add to the store of useful knowledge? Is it really important? Can it be accomplished in reasonable time and with the facilities that can be made available?

If the problem stands the test of justification we are ready for the second step.

Step Two—Problem Statement

The importance of the problem statement cannot be overestimated, because it gives direction to the research. In this step the problem is appraised as observed with respect to the difficulty it is causing; or the characteristics to be determined. The observed phenomenon, or effects, which gave rise to the need of research, should be stated. The problem statement may or may not state the results anticipated through research.

This is the time to appraise the problem for size. Can it be broken down into several small components? If so, will it not be better to consider each of these components as a separate research project and prepare an individual project statement for each?

The problem statement as drafted should define the problem accurately and concisely, and narrowly delimit its scope with respect to time, place, and condition. The problem statement tells of effect, the cause is assumed to be sought, as is also the change occurring through variation of stimuli.

***Engineer of Traffic and Operations, Highway Research Board.**

When the draft of the statement has been written it should be reviewed by others for clarity, and completeness, to see if it means the same thing to the reviewer as it does to the writer.

This draft will be a tentative one, for the problem must next be considered in the light of all the recorded observations of other researchers which might relate in any manner to this problem. So this brings us to step three.

Step Three—Bibliographic Search

Thomas A. Edison said, "The first thing to do is find out everything everybody else has done, and then begin where they left off." To do this gives one a head start, prevents duplication of effort, gives clearer insight into the problem, and the techniques for solving it. And there is the possibility too that you may find the problem already solved by someone else. So make friends with your librarian —tell him exactly what you want and you will find an ally in your search.

In compiling a bibliography, the title of the book, author, publishing firm, year published, and pages on which subject matter of interest appears should be recorded, together with any other pertinent data that will help in locating or identifying the publication. Each reference should be placed on one side only of an individual card. A short annotation of the publication may be in order if the bibliography precedes further work for any length of time. With the bibliography completed we are ready for Step Four.

Step Four—Critical Digest

At the same time the bibliography is being compiled, or independently thereof if more practicable, pertinent excerpts are copied from the publications. These should be arranged in chronological order so far as possible to show development and progress in research on the problem.

Bring together the findings, techniques, and pertinent observations of previous researchers for comparison and then add your own critical comments, bringing out the difference in findings if any, and point up any apparent fallacies, errors, or inconsistencies in the light of your experience and reading. This thorough digest will reflect itself in the modified problem statement which should be prepared immediately after the completion of the critical digest. The problem statement and the critical digest should have sharpened the mind for the next step.

Step Five—Technique Formulation

Techniques point toward laboratory investigation, hence the facilities which can be made available must be kept in mind. Either the techniques must be designed to fit the facilities or the research postponed. Techniques must be devised to measure the relationship of cause and effect, the character of the stimuli, and the resultant phenomenon.

Out of his experience the researcher will list all of the possible changes or behavior which may take place in the subject of study, together with all of the stimuli which may be responsible for the change. The critical range of variable stimuli (e.g. range of temperature) within limits sought will be noted. A complete circle of conditions must be set up. The activating factors are sought—the stimuli that obtain responses. It may be found after testing that some factor produced no reaction within the critical range, nevertheless it were better to include a negative factor than to omit a positive. To illustrate, the question of what age produces the most dangerous automobile drivers has been raised. This is different from the question of which ages produces the most accidents. The first question includes the factors of age, accidents, and exposures, whereas the second includes only two factors: age and accidents. So we must know what answer we want to get before we can complete our circle of condition factors, before we can use discrimination in inclusion and exclusion of factors. This is another reason for a definitive problem statement.

Again we find that not only one simple action, but more often interaction, causes effects. In pavement performance, it is not alone the action from the surface down, or from the surface up, that is responsible for the performance, but it is the combined interaction of pavement, subgrade and traffic, each with its own peculiar characteristics that determines the behavior of the pavement, again that determines the behavior of the subgrade, again that determines the behavior of traffic. So we see that the combined interaction effects each of the component parts.

Sometimes a graph, or flow chart, showing the stimuli, or condition factors, their critical range, their interrelationships, their order of application, will be helpful in showing visually the research process. Again, a check list of possible factors which should be considered in the technique will possibly prevent the overlooking of some important factor that might appear negative or make untenable the results of the research. Again, two heads may be better than one, and it is the better part of wisdom to have two heads work on the techniques separately, than later jointly.

The task of the researcher is to measure. The measurements most often required are of mass, time, and length. The researcher must recognize and measure accurately all the forces which act to effect stress, and must measure all the resultant stresses, or the effects of stress as shown in strain or behavior, the duration of the stress and permanent change resulting. He must know where, when and how to make these measurements.

When the techniques are formulated it is well, if possible to do so, to have them reviewed by specialists independently. Sometimes the testing is done by an assistant and the controls for testing must be so specific that two testers working independently will get the same results from the same test. When the techniques are satisfactorily formulated we move on to the next step.

Step Six—Investigation

We come now to the measurement of cause and effect. Reliable and accurate instruments for measuring time, space, mass, and energy in their dynamic manifestations are required. The scaler values should be in accord with the required precision in application. If physical senses are to be used, they should be tested by standards, and then matching devices (such as color matching charts), and other controls used.

How many identical tests shall be run? This depends of course on the specific test and the allowable error, and the quality of control used in testing. If controls are perfect, a second identical test is not needed, but we cannot always be sure of control of known factors, not to mention the possibility of unknown factors.

Record keeping is vital to the success of research. An accurate, complete record of each test, with controls, and measurement of cause and effect must be kept, even though results are negative, or freakish. Intellectual honesty is a must in the laboratory as well as in the analysis section.

With the series of investigations completed, checked, and recorded, we go to the next step.

Step Seven—Analysis

Analysis is the process of examining to distinguish component parts, separately or in their relation to the whole. The work consists of assembling and tabulating the results of the investigations in such a manner that any significant findings will become evident.

In mathematical analyses machine methods of sorting and tabulation are often helpful in saving time. Along with mathematical analysis graphical analysis is a handy tool. The plotting of curves for visual interpretation often will reveal critical values quicker than mathematical tables. Maximum and minimum values are quickly obtained. Changes in direction of curves and changes in rate of change should be studied for significance.

In the plotting of graphs it is easy to discover any exceptions. Exceptions test the rule for its veracity. The exceptions may actually not be exceptions but may reveal a limiting value of the critical range. On the other hand the exceptions may be a "happenstance" or an "accident" resulting from inadequate controls, or incompleteness of factors, or the presence of unknown factors, or inadequacy in sample size. Chance is the absence of assignable causes. In the case of exceptions we should try to assign the cause and if impossible to do so, try to do the test over that gave the exception.

There are many publications relating to statistical and graphic analysis, probability, theory of errors, etc., available to the analyst hence detailed methods are not in order here. So I conclude this step with a word of advice: go back and review the problem statement and techniques, so that you will know what is sought. Maybe the answers from the testing are not what was anticipated, but usually the problem statement gives direction to analysis, and the results wanted are more quickly found thereby.

Step Eight—Findings

The findings, or conclusions, are the final decisions, the outcome of the research. Every significant finding should be reported whether positive or negative, and the findings qualified as to time and place. The findings are the crux of the matter. Up to now everything has pointed to the findings, the rest of the work will point back to them. So the findings should be carefully reported. Findings are not recommendations, they represent a summary of effects as related to cause and condition.

There should be no retouching, no addition, no subtraction, no slanting, no highlighting, no shading to the findings, no general conclusions from limited evidence, no undue substance given to a mean value in a wide range of values.

The report of "Findings" serves as a guide in the choice of a course of action. It should therefore be concise, clear and conclusive. It should be so plain that it cannot be misunderstood. If intended for the busy administrator, omit philosophy, tengential discussion and Washington prose. Every word should be weighed for meaning and every sentence for content.

Finally, every project should be reported, and records kept, so that others will not travel the same path and duplicate our effort.

Step Nine—Interpretation

To interpret is to explain the meaning. In research it means to explain the "Why" of findings, to state the law, and then to progress to an explanation of the meaning of these laws in their possible application, their correspondence to environment, and their validity in a changing world. Interpretation seeks to relate cause and effect, stimuli and response, action and reaction, to a law of conduct and say "under these conditions" the law operates. Interpretation brings in the when and where constants ($Y = X^2 + C$), constants which do not alter the truth but reveal its time and place.

Step Ten—Recommendations

Recommendations contemplate an action program growing out of the findings. Sometimes the recommendation of specific action is unwise as it enters into the policy field which is a prerogative of the administrator who can himself reason from the findings to the appropriate action, and who must weigh the relative merits of any proposed action stemming from a report against other possible reaction. It is the duty of the administrator to evaluate the constant of where and when in application. However, the recommendations, if made a part of the report, can consider the economy of a proposal on the basis of cost-benefit.

If a host of findings ensue under varying conditions the research engineer will weigh them and assign priority

ratings to the several findings if they be presented as recommendations.

In thinking of a recommended action program the researcher would do well to justify it on the basis of the following questions:

1. Is it possible?
2. Is it practicable?
3. Is it economically feasible?
4. How does use quotient compare with benefit-cost ratio?
5. Does it solve the whole problem, or just a part?
6. Can solution be applied universally, or in specific cases only?
7. What will be the result of discriminatory usage?

It is common practice to publish research reports in two or three sections, placing recommendations in a section by itself.

Summary

In summarizing the steps of research we can relate the questions of the curious child to the steps.

"What" is usually the child's first question and it is related to our first two steps: *Project Selection* and the *Bibliography*.

"What for" is related to our *critical digest* in which we face the problem of purpose, and in our *Problem Statement* in which we reveal the present difficulty and our anticipations.

"How" is related to our *Formulation of Techniques* in which we set up the ways and means of proceding in research.

"When and Where" are related to *Analysis*, and *Findings*, in which we evaluate the truth discovered in terms of time and place.

"Why" relates to interpretation, in which we discover the relation to cause and effect through the operation of a natural law.

Now, a word to you who are students of traffic engineering. In dealing with the inanimate world we may assume that effort is conditioned upon environment, that all stimuli are external. In human behavior, however, we find that phenomenon is not conditioned solely upon the immediate environment, that subjective forces are at work, that habit, intelligence, and moral character and other factors act as stimuli, often exerting sufficient force as to constitute the principal or proximate cause in observed phenomenon of behavior. And these stimuli come not at a time to participate in the determination of our choice of behavior, but they are present in phalanx.

We are lacking in the science of behavior because these subjective stimuli are not as readily brought out into the open, nor as susceptive to quantitative measurement. The field of human behavior challenges the scientist to perfect techniques and instrumentation to evaluate these subjective stimuli with respect to the part they play on human behavior. Length, mass, and time have been measured in a multiplicity of their dynamic manifestations, but the motivating influences of the human mind remain in the realm of the mystic.

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Urban Intersectional Right Turning Movements

by GERALD R. CYSEWSKI*

Ed. Note: This article is based on a thesis of the same title which was prepared by Mr. Cysewski while he was a student at the Yale Bureau of Highway Traffic. It can be appreciated that in an analytical study of this type, graphical presentation of the data is more readily understandable. Because of space limitations, many of the original figures had to be omitted.

The intersection of urban streets is one of the principal locations of accidents and a primary source of congestion. Through analysis of vehicular behavior adjacent to and within these intersections and the rational application of the derived information the undesirable conditions may be possibly reduced or even eliminated.

Vehicular behavior is a combination of the physical limitations of both the vehicle and the driver as modified and complicated by the psychological attitude and concept of the individual. The understanding of this involved behavior is not accomplished through cursory inspection of vehicular movements but only through thorough analytical methods.

This investigation concerns only right-turn vehicular movements at urban intersections. Such movements normally vary the headway of vehicles, utilize a portion of intersections, and promote congestion, especially with increased volumes. It is desirable to facilitate these maneuvers to promote greater fluidity of the traffic streams on existing streets.

The complex in-line movements of traffic at urban street intersections are treated in the Technical Bulletin No. 1 of the Bureau of Highway Traffic, Yale.[1] It is not the intent here to either corroborate or evaluate the detailed findings of that publication but to enlarge upon the understanding of the normal vehicular behavior. This is an attempt to derive information valuable in the control of existing conditions and in the future design of intersections and channelization.

Since passenger cars compose the majority of urban traffic and since sufficient trucks to constitute a fair sample were not recorded this study is limited to passenger vehicles.

The taking of time-motion pictures at pre-determined short successive time intervals was selected as the most feasible method of gathering the data on moving traffic. This method furnishes a sufficiently accurate and complete record of the activity within the field of view of the camera.[2] Through the use of this method many formerly intangible or unnoticed stimuli or conditions become a portion of the permanent record and enable more rational treatment or selection than other methods. Other advantages are that a permanent record is made which may be rechecked and that the drivers are unaware that measurements are being made.

Intersection Studied

For the purpose of this investigation it was highly desirable to select an intersection where a predominance of free-turning movements was evident. This necessitated the absence of traffic signals which might have psychologically influenced the motorist's behavior. The predominance of either vehicular or pedestrian cross-traffic was also undesirable as was a heavy flow of opposing traffic upon either the street being vacated or that being entered. Streetcar tracks were also ruled out, as was the evidence of rain or snow which might have an undetermined effect upon the motorist.

In the selection of this intersection for analysis it was necessary to insure an available elevated position from which to take the time-motion pictures which would also enable coverage of the two streets from and to which the turns were being made.

The intersection selected was in the city of Hartford, Connecticut, at the junction of Trumbull and Wells and the intersection of Lewis and Gold. *Figure 1* shows the intersection, as viewed from the observation point. The vehicular movement selected for analysis was from Wells turning right into Gold.

Gold Street was utilized for one-way movement only and the interference of opposing traffic was absent. The width and alignment of Wells enables separation of right-turning traffic prior to the intersection approach. Traffic from Lewis into the intersection was relatively light and did not interfere seriously with the observed movement. Parking was prohibited on the left side of Gold Street for 56 feet and on the right side of Wells in the block adjacent to the intersection of study.

*District Traffic Engineer, State Highway Department, Seattle, Washington.

[1] *Greenshields, Bruce D.; Schapiro, Donald; Erickson, Elroy L.: Traffic Performance at Urban Street Intersections.*

[2] *Greenshields, Bruce D.; The Photographic Method of Studying Traffic Behavior.*

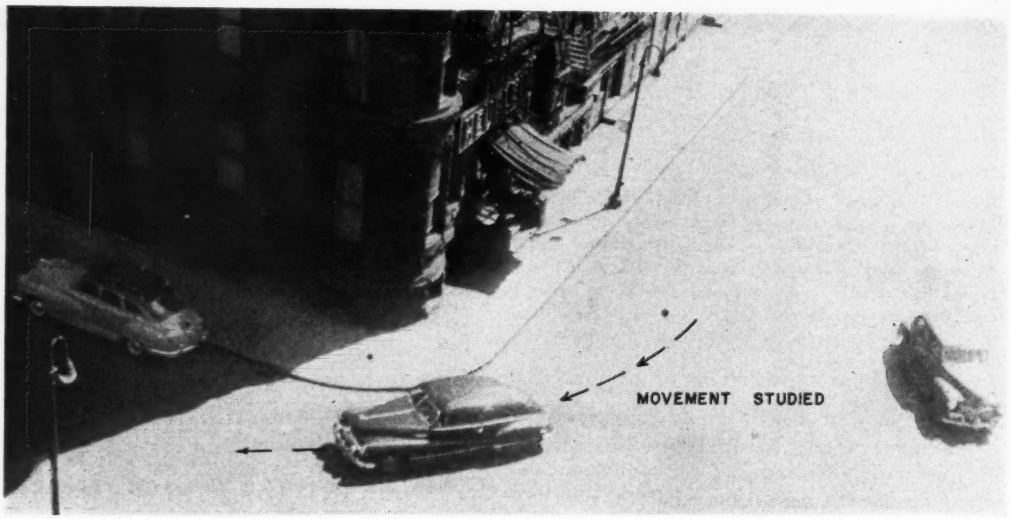

FIG. 1

Prior to the collection of the vehicular behavior data the physical characteristics of the intersection were determined. These included the crown of the intersecting streets, radius of that particular curb return being passed in negotiating the turn, the width of the two intersecting streets, and the intersection angle.

A cartesian coordinate system was marked at intervals of ten feet in both directions on both the street of entry and that of exit to provide a base for the later analysis of the recorded information. The markings were four inch circles of chalk on the pavement and curbs in both directions on both streets for fifty feet from the curb return tangent.

Grid Systems

In this study three types of constructed grids were used in addition to the reference grid points marked on the pavement. The first hereafter designated as the "perspective grid", is that constructed through projection of the time-motion pictures on a flat surface and marking the location of the Cartesian coordinate reference points previously placed on the pavement. This grid is used in reading vehicular placement for each projected picture frame.

A vanishing point for two parallel lines, such as the curb lines or the coordinate lines marked at ten foot intervals, is found by projecting these to a common point. The intersection at that same point of the reference point lines parallel to those curbs was a check on the accuracy of the coordinates marked on the pavement and of the camera or projection lens distortion. The film was projected on the white bristle board and the location of the curb lines and reference coordinate points marked. Then the perspective grid was constructed. Since the pictures were taken in a direction more nearly parallel to one of the intersecting streets than the other, only one vanishing point was clearly defined. The other vanishing point does exist but at some distance from the intersection as pictured in this perspective. These other lines were drawn through the marked coordinate points and their accuracy checked by proportional dividers.

The second system will be referred to as the Cartesian grid and is a scaled drawing of the coordinate system reference on the pavement. This grid does not embrace true Cartesian coordinates since the original coordinate reference points were placed at the same distance from the two curb lines and those curb lines did not intersect at an exact right angle (92° 56′). This grid is used in plotting the position of the vehicles in each individual frame as read from the perspective grid.

The third system is the analytical grid *(see Fig. 2)*, which is used in defining vehicular placement from the curb line and speed behavior. The sections numbered 1 to 12 are arbitrarily designated at a frequency that will enable ready vehicular behavior definition and analysis.

The data recorded on the photographic film was projected on the constructed perspective grid. The position of one of the front wheels of a vehicle was read. This vehicular reading for each frame was then plotted on the Cartesian grid. After the points for the vehicle path were plotted throughout they were connected by a well-faired curve via a flexible spline. Attempts to fair these points with a French curve of second or third degree at each end and a circular curve in some midpoint proved impractical.

The filmed information was sufficiently accurate and in enough detail so placement readings to the nearest

quarter foot could be made. In all instances the outside (left) front wheel was used as the point of reference for the study.

Early attempts to determine the true tracking characteristics of the vehicles were not sufficiently accurate to provide significant data for a comprehensive analysis. The placement of the rear wheel was therefore not plotted.

Space Utilization

In order to define vehicular behavior the "space utilization" concept was employed. The space actually occupied by the tread of the front wheel of the vehicle in passing any section was considered as five feet and the space occupancy plotted on the space-utilization graphs is five feet in width. Thus a vehicle with its left front wheel found to be within the 10 to 11 foot area at section 4 was plotted as occupying the area from 6 to 11 feet at this section. This was done so the frequency of use of any area by the vehicles is pictured. The space utilization graphs are plotted on the analytical grid with the base lines arbitrary sections (numbered 1 through 12) perpendicular to the curb and the ordinate denoting frequency of space use at one foot intervals from the curb, used as a reference.

The median of the space utilization graphs is plotted on each of the graphs for each speed range and is hereafter referred to as the median.

One of the fundamental concepts in determining turning behavior is that of speed. It was desirable to segregate the turning vehicles into various speed ranges. The speed of the vehicles upon entering the turning area was probably indicative of that which the drivers wished to use or thought they could use from either their past experience or their concept of the intersection as viewed from the approach. Since an observation of the vehicle just after the turning had been started would not introduce great parallax errors, the entering speed of a vehicle was determined when that particular vehicle had turned fifteen degrees from the approach tangent whether that point was either adjacent to or relatively remote from the intersection.

The speed of the vehicles negotiating the turn was directly readable from the paths plotted on Cartesian coordinates.

The speed distribution of all observed vehicles that were free-turning shows a relatively steeper grouping on the higher side. This probably indicates an inherent desire of the drivers to negotiate the turn at a higher rate of speed. In this distribution the mode and median both occur between 12 and 13 miles per hour while the mean is at 11.7 miles per hour. This would then indicate a fair speed distribution sample.

From this sample it was desired to determine definite extremities of speed and paths that would more closely define normal behavior habits and exclude the abnormal. From plotting a distribution curve of the approach speed it was readily seen that exclusion of any certain percent of the total range of speeds would not be just, since the determined boundaries would then not be even approximately symmetrical about the original mode, median, or mean.

The grouping of the resultant distribution would be more distorted toward the higher speeds. These speeds were found to usually vary throughout the paths of the vehicles. In vehicles approaching the intersection at a relatively high speed, this change was one of deceleration until the turn was about two-thirds accomplished. Then, in completing and leaving the area, resultant acceleration of the vehicle was noted. This deceleration-acceleration behavior was due in part, at least, to the energy consumption by the cornering force during negotiation of the turn.[1] The extent that this speed change was affected by the driver's intangible behavior such as braking and accelerating could not be determined here. Vehicles approaching the intersection at relatively slow speeds were often found to accelerate throughout the turn in negotiating the corner.

In view of the complex and varying speed pattern noted and that any arbitrary limitation might induce intangible errors the total speed range is considered and defined into speed groups. Since the observed speed range of the vehicles accomplishing the turn did not normally vary over two miles per hour, the observed data have been segregated into speed groups of two miles per hour. Any vehicular path included within any group then negotiated the turn at speeds wholly, or for the most part, within the defined limits. At the slowest speeds, seven to ten miles per hour, the speed group has been arbitrarily assigned the three miles-per-hour range to insure a sufficient sample for analysis.

The median of vehicle paths for any selected group was used as the basis for comparison. This does include the total of all paths, extremes included, but does not either unjustly weight the extremes nor eliminate the utility of the data throughout its entire range.

Effect of Parked Vehicles

Parking was observed on the right side of the streets of this study at various times, although a parking restriction existed on the street of entry. In the great majority of the observations a vehicle was parked on the street of exit six feet from point of curb-return tangency. Sufficient data was not available to thoroughly correlate this predominate condition with that where there was no parking within the space. The correlations possible were those of vehicular paths as influenced by various vehicle parkings on the restricted street of entry.

The placement paths of vehicles traveling at various approach speeds when a vehicle was parked on the street of exit six feet from the curb-return tangent and no parking existed on the street of entry was analyzed by

[1] *Fox, Merritt L.; Relations Between Curvature and Speed; Highway Research Board Proceedings; Volume 17, 1939; Pages 202-211.*

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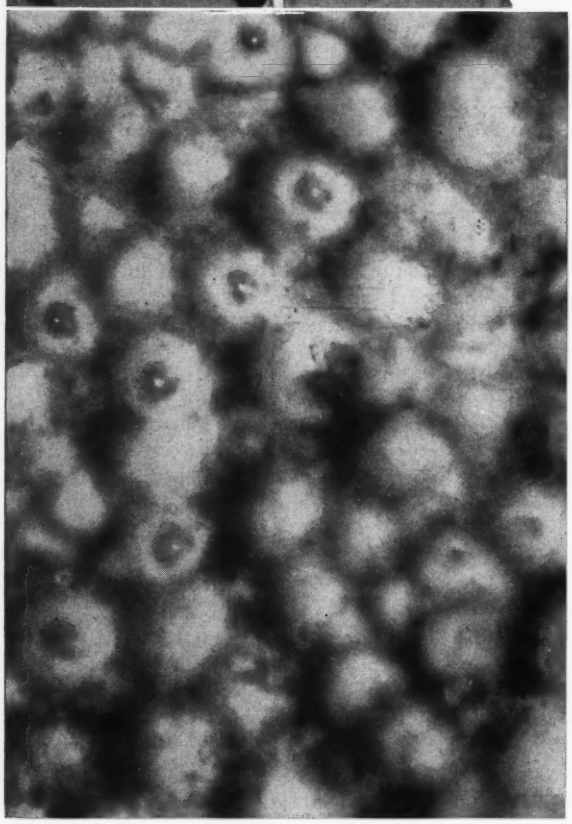

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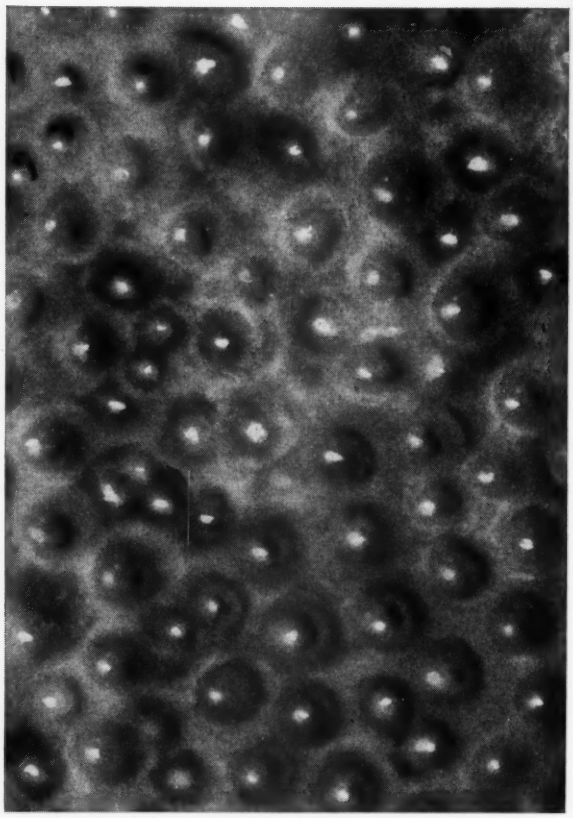

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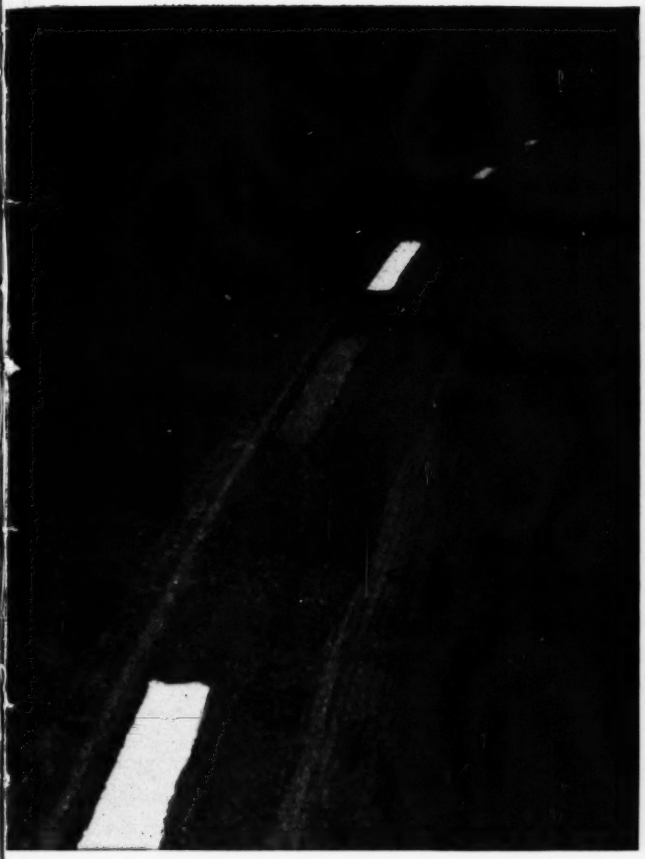

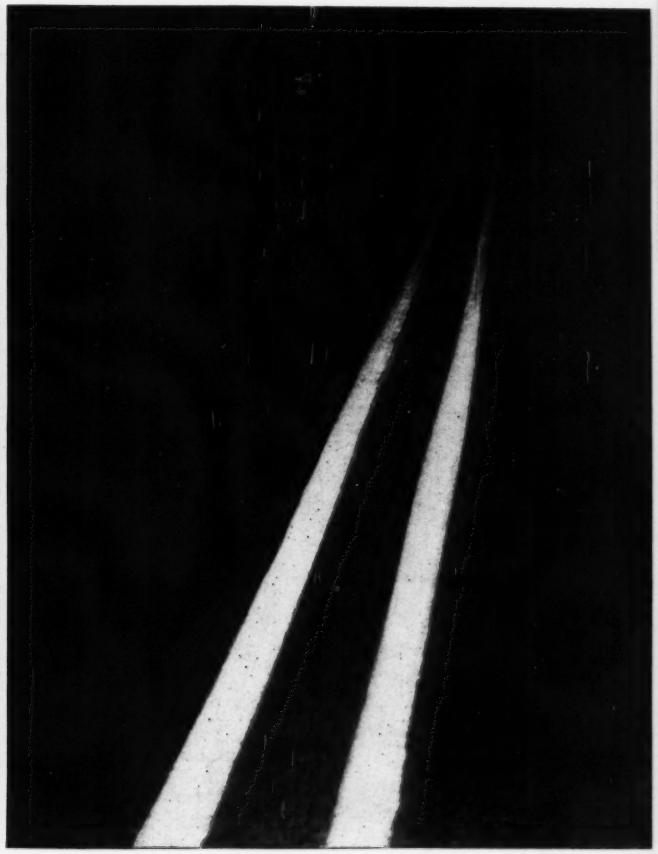

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plotting the space utilization for each of the speed groups on analytical grids.

The slower drivers appeared to be more cautious, since they select greater clearances from both the parked vehicles and the curb. The drivers entering the intersection at 7 to 10 miles per hour have a median path of space utilization that approaches seven feet as a minimum for the curb return clearance and eight feet nine inches for the parked vehicle clearance. These median clearances decrease as the entrance speed of the vehicles increases as shown in the table below.

MEDIAN CLEARANCES WITH PARKED VEHICLE ON STREET OF EXIT

Entrance Speed Range in m.p.h.	Minimum Median Clearance of Space Utilization		
	Curb Return	Parked Vehicle	Difference
7—10	7′—0″	8′—9″	1′—9″
10—12	6′—6″	8′—6″	2′—0′
12—14	6′—0″	8′—3″	2′—3″
14—16	5′—3″	7′—9″	2′—6″

From this correlation it is indicated that the parked vehicle is in all cases regarded as the greater hazard and is given greater clearance latitude. The decrease in the clearance with speed increase is greater for the curb return than for a parked vehicle. This further illustrates the relative hazard placed upon each of these obstacles. The result of this arbitrary hazard evaluation evidences itself in faster driving motorists transgressing closer to the curb in attempting to negotiate a longer over-all radius. Although the minimum radius used in the various speeds does not vary appreciably, the total rotational movement accomplished during the utilization of this radius does. The faster moving vehicles maintain this shorter radius for less time, for less distance, and accomplish less angular change than the slower vehicles.

The close behavior similarity of the various speed groups indicates either the confident expression of the more capable and/or faster drivers as compared to the slower and more cautious ones and in the acceptance by the faster drivers of a relatively high side-friction factor.

The drivers of the various vehicles assumed an angular positioning with respect to the curb prior to entering the near proximity of the intersection and retained a certain relative bearing to the curb in leaving the intersection. The field of coverage as restricted by both the camera lens and the building proximity did not enable full analysis of this approach and exitus behavior. From the relative angular bearings of the median paths certain behavior patterns are indicated. At section 1 the slower moving vehicles assume more of an angle to the curb with preemptory turning than the faster vehicles while at section 2 on the street of exit from the intersection these slower vehicles have more nearly or fully completed the 90 degree angular change. Thus the slower moving vehicles start the turn negotiation relatively earlier than the faster vehicles but also complete this movement before the others.

The placement distribution of the vehicles at the radial sections (7 through 10) varies for the different speed groups. This distribution is distorted toward the curb-return for the slower speeds but appears more nearly normal as the speed increases. This would indicate a desire of the drivers to maintain a minimum clearance but that desire as modified by the driver's more-limited judgment at higher speeds yielded a more-nearly normal distribution.

The clearances of the parked vehicle may not be significant except as a result of the curb clearance acceptance and the limitation of the side-friction factor with body roll consideration. This remains to be seen from clearance acceptance of vehicles parked also on the street of entrance.

The speed with which the vehicles negotiate the turns is valuable in determining lowered capacity of streets due to parked vehicles near intersections. *Figure 2* shows, on the analytical grid, the speed behavior of all observed vehicles negotiating the turn in question with a parked car six feet from the curb return tangent on the street of exit. The abscissa is speed in miles per hour at each section and the ordinate is the frequency that speed was observed at that section.

A definite deceleration is noted at section 1 to 2 for those vehicles approaching the curve. The field of view

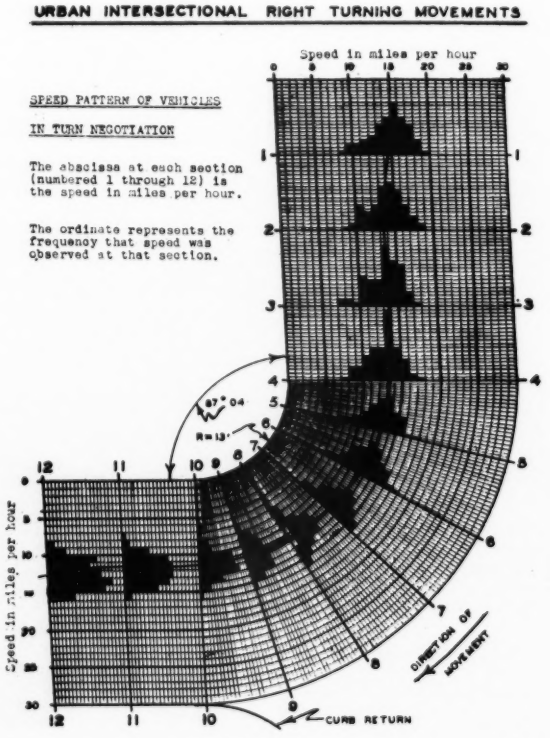
URBAN INTERSECTIONAL RIGHT TURNING MOVEMENTS
Speed in miles per hour
SPEED PATTERN OF VEHICLES
IN TURN NEGOTIATION
The abscissa at each section (numbered 1 through 12) is the speed in miles per hour.
The ordinate represents the frequency that speed was observed at that section.
87° 04
R=13'
Speed in miles per hour
DIRECTION OF MOVEMENT
CURB RETURN

FIG. 2

of the camera and parallax limited further investigation of this approach speed behavior prior to section 1. The speed distribution distortion at section 1 toward the higher speeds indicates a higher approach speed than recorded here.

As mentioned before, the definite slower speed adjacent to the curb return is, in part at least, due to the energy consumption of cornering force. The driver behavior in accelerating or braking remains an intangible factor.

Speed recovery is started prior to the completion of the turning movement. This recovery is not readily noticeable for those faster vehicles having their minimum radius nearer the end of the turning path.

Most minimum radii, whether evidenced relatively early or late, were present in passing through section 8 of the analytical grid. The speeds at this section were used in evaluation of the side-friction factor acceptance. These side-friction factors were calculated with consideration of the effective superelevation due to the crown of the intersecting streets. The maximum side-friction factor used was 0.35 and the 85th percentile was 0.24.

This, in conjunction with the normally accepted 85th percentile used in speed zoning, would indicate that the radius of vehicles within any channelized area should be such that the side-friction factor at the speed limit does not exceed 0.24. This would then allow the legal speed vehicles smooth passage without the necessity of a varying speed pattern. The faster vehicles would be speed-controlled at the channelization and placed in step with possible merging traffic ahead.

From the pattern of speed behavior and placements it seems that motorists try to negotiate each turn with the minimum of time at their respective approach speed but are limited by the centrifugal force.

From these clearances it is again shown that parked vehicles are considered greater hazards than curbs by motorists. Any path selection to permit a longer overall radius will evolve a closer transgression to the curb return. This substantiates the indications of placement behavior found when a vehicle was parked only on the street of exit.

The speed pattern of vehicles negotiating the turn with the parked vehicles both on the streets of entry and of exit very closely duplicates that for the condition of the parked vehicle only on the street of exit.

Space Utilization Limits

The extremes of the space utilization graphs with a parked vehicle on the street of exit only also include the area used by those vehicles negotiating the turn with parked vehicles both on the street of entry and that of exit. This shows that the parked vehicle on the street of entry did not cause a placement shift throughout the range. The effect was, in reality, to restrict or channelize that normal distribution on the curb side.

From the space utilization graphs here the channelized extremities of vehicular use are defined. Since the movement being analyzed is free turning, it would follow that channelization accommodating the normal extremities would not unduly inhibit proper behavior within the maximum speed analyzed. It also follows that speed in excess of that analyzed may direct behavior outside the placements set forth and that an effective speed control device would exist in the channelization.

The extremes of all vehicles with immediate approach speeds up to 16 miles per hour are shown in *Figure 3* which indicates the definition of space utilization limits within an error of one foot.

It must be remembered that the defines shown are for the actual space utilization and do not consider the curb clearances necessary in channelization. The proper channelization design should be such as to direct behavior for this type of turn within this defined area.

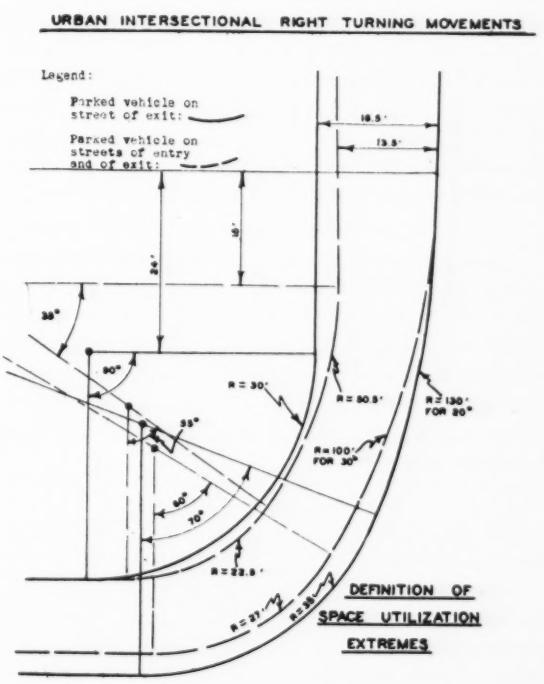

FIG. 3

As noted before those drivers selecting wider placement clearances from the curb upon the turn completion and those with relatively small clearances at entry were forced into wider placements at exit. It would follow from this that enforced wider placement should evolve a narrower over-all space utilization area. This area should be closer to the curb on the street of exit. This is well illustrated by the channel extremities when a vehicle was parked only on the street of exit. The enforced placement by the parked vehicle on the street of entry does eliminate a certain amount of the juxta-position of the vehicular paths and actually directs behavior beyond the actual vehicle location.

This behavior illustrates well the desirability of proper entrance design in channelization and in ramp interchanges. The wider latitudes offered in some entrances to channelized areas may often be an invitation to improper behavior whereas definite design constriction of the entrances may direct behavior within the confines necessary.

Summary

The analysis indicates that the path a vehicle takes in making an urban intersectional right turn is a composite of the relative hazard clearances the driver selects modified by the body roll and/or side-friction factor his psychological attitude and past experience directs.

From the information gathered the following tentative conclusions are drawn:

Approach Behavior

The immediate approach speed distribution of vehicles negotiating the turn is distorted toward the faster speeds. The maximum speed found was 16 m.p.h. and the 85th percentile was between 14 and 15 m.p.h.

Slower drivers begin preemptory turning farther from the intersection than the faster motorists but complete their turn negotiation in leaving at less distance from the intersection.

A curb-parked vehicle thirty-five or more feet from the intersection on the street of entry does not affect turning motorists' speed behavior.

Clearances

Curb returns are regarded as less hazardous than parked vehicles by motorists. Any arbitrary clearance acceptance will be less for the curb return than for the parked vehicle.

Faster drivers select lesser clearances from both parked vehicles and the curb return than their slower counterparts.

Clearance selection becomes progressively smaller at a faster rate for curb returns than for parked vehicles with increased motorist speed.

Turn Negotiation

The minimum radius used at any time by the motorists here was 40 feet.

Minimum radius used during the turn negotiation does not vary with the speed range studied but that radius is maintained for less time and distance and accomplishes less turning for the faster vehicles.

The minimum radius is evident at all speeds within the range studies when that vehicle has turned 60 degrees from its approach tangent.

The maximum side-friction factor used by the motorists in turning is 0.35 within this speed range. The 85th percentile is 0.24.

The speed pattern of motorists will not normally vary over two miles per hour during actual turn negotiation. The start of speed recovery of that lost is evident after the turn is ⅔ (60 degrees) completed.

Vehicles approaching the turning area at relatively low speeds may accelerate throughout the maneuver.

General

A correlation of turning behavior with time required to complete the maneuver will give essentially the same results as with an approach speed segregation.

A curb-parked vehicle on the street of entry 35 feet from the intersection does effectively channelize turning movements both on the street of entry and that of exit.

Present curb-return radii are much too short to facilitate free turning maneuvers at even low speeds of 15 miles per hour without turning-vehicle transgression into the opposite side of the street being entered.

SAN FRANCISCO BAY . . .

(Continued from page 9)

number of communities and their people. Each of the principal approaches was examined with this purpose in view, and extensive changes and modifications were recommended in the consultants' report.

Bay Crossing Capacities and Future Traffic

The following tabulation gives the conclusions as to the "comfortable" capacity of the recommended bay crossings at each stage of progressive construction and expansion. The tabulation also shows the year in which estimated total trans-bay traffic may be expected to approximate the comfortable capacity of the then existing trans-bay facilities.

Time and Cost Estimates

The short time available did not permit the elaboration of close cost estimates and time schedules for construction. However, it is believed that the following program is feasible and the cost estimates adequate as an indication of the practicability of financing the recommended plan and procedure.

TABLE III. COST AND FINANCING ESTIMATE FOR BAY BRIDGE LOWER DECK RECONSTRUCTION AND SOUTHERN CROSSING

Bay Bridge Lower Deck Reconstruction		
Track Removal, Paving, Vehicular Ramps, Reconstruction of Rapid Transit Terminal and Ramps, Real Estate	$ 7,000,000	
Additional Toll Lanes in Oakland, and Allowances for Engineering, Contingencies and Legal and Insurance Costs		
Purchase of Interurban Equipment (Trains plus new buses)	12,000,000#	
Total for Bay Bridge Lower Deck and Key System		$19,000,000
Southern Crossing		
Construction Costs		
Bay Crossing proper	63,684,000	
Approaches	51,000,000	
*Miscellaneous Items	1,216,000*	
Total, Construction Costs		115,900,000
Real Estate		10,708,000
Contingencies, Engineering, Legal, and Insurance		21,800,000
Total for Southern Crossing (round figure)		148,500,000
TOTAL COST, Bay Bridge Lower Deck plus Southern Crossing (rd. fig.)		167,500,000
*Debt Retirement (existing bridge bonds)		22,793,675
Capital Reserve		4,000,000
TOTAL FIRST PHASE FINANCING, March 1, 1950 (round figure)		$194,500,000

#This allowance is based on testimony at a public hearing
*Division of San Francisco Bay Toll Crossings' Estimate

Reconstruction of the upper deck should be undertaken upon completion of the Southern Crossing, expected in 1955, in order to assure completion before traffic demand exceeds the capacity of the Southern Crossing plus the reduced capacity of the Bay Bridge during the construction period. Financing is judged to be feasible at any time after 1955.

TABLE IV. COST ESTIMATE FOR BAY BRIDGE UPPER DECK RECONSTRUCTION

Cantilevered lanes, dividing malls, and necessary improvements to approach ramps and toll collection facilities; contingencies; engineering; and legal and insurance costs	$31,000,000
Real Estate	5,000,000
Total, Upper Deck Reconstruction and Approaches	$36,000,000

Summary of Conclusions

It is the opinion of the consultants that the aforedescribed plan for the construction of the Southern Crossing with a four-lane causeway and tunnels, in conjunction with the existing bridge to provide on the lower deck four lanes for mixed traffic and on the upper deck eight lanes for passenger cars and light vehicles, offers the best and most economical solution of the problem of providing additional traffic facilities between San Francisco and the East Bay area.

HIGHWAY PLANNING . . .

(Continued from page 15)

ing rate, and still be miles from her destination. This may likewise be true of much of the employee population of the congested areas.

Let us not forget *structural revision and planning.* In the mass of plans I have seen, only one or two have provided that new structures *must* have adequate loading facilities! City ordinances should be enacted to cover new buildings, and building owners should be interested in revising loading facilities. They should know that maintenance of property values is directly related to their ability to maintain free and ready access for their tenants by the trucks bearing the goods, wares, or merchandise with which their tenants do business.

I shall close with this one recommendation which should bear fruit. Every city has traffic problems peculiar to itself. Hence in every city we should find a *Traffic Advisory Board* which passes on all matters relating to traffic. The Board should be made up of representative retailers, wholesalers, real estate men, property owners, architects, city engineers, planners, police, the mayor's office, and last but of great importance—*city transit, local truckmen and over-the-road truckmen.* The city should establish such a Board by ordinance, not merely as a political palliative but empowered to adopt necessary traffic regulations. The city should furnish an adequate staff to carry out necessary surveys, etc. Such plans produce more results than any other known present activity designed to solve our problem, if properly constituted and with *competent* representation of two or more persons from each interested group.

OHIO PAVEMENT . . .

(Continued from page 17)

no-passing lines. The no-passing line is separated from the center line by a space of 3 inches.

To mark the more than 10,000 miles of centerlines, lane lines and yellow no-passing zone lines in Ohio each year require some 150,000 gallons of white and 50,000 gallons of yellow paint—a total of 200,000 gallons—sufficient to paint over 13,000 houses at an average of 15 gallons per house. The paint is applied at the rate of 15 to 17 gallons per mile.

All of the 50,000 gallons of yellow paint and 70,000 of the 150,000 gallons of white paint are of the glass bead type which is luminous under the rays of motor car headlights.

Air Curtain Guide Plates

For Perfect Traffic Lines:

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21 State Highway Departments and 5 Canadian Provinces are users of Kelly-Creswell equipment.

Reference Notes

by JEROME D. FRANKLIN
City Traffic Engineer
Grand Rapids, Michigan

The accompanying nomograph can be used to determine graphically the relationships between vehicular volume, cycle length, and total clearance time.

The vehicular volumes are those commonly found in both rural and urban areas, and are based on a standard ranging from 0 to 2,000 vehicles per lane per hour.

The cycle lengths are those most frequently used in modern traffic signal equipment and range from 40 seconds to 120 seconds.

The total time required for vehicles to clear the intersection from any approach is based upon the initial vehicle requiring a headway of 5 seconds and each succeeding vehicle requiring a headway of 3 seconds. These values were found to be representative as they usually account for delays resulting from turns, and slow starts by the initial vehicle upon receiving a green light.

For example, if a traffic count showed that the major approach to an intersection handled a peak hour load of 600 vehicles, and it was desired to find out if a 60 second cycle could effectively handle the volume, the following steps are all that would be necessary:

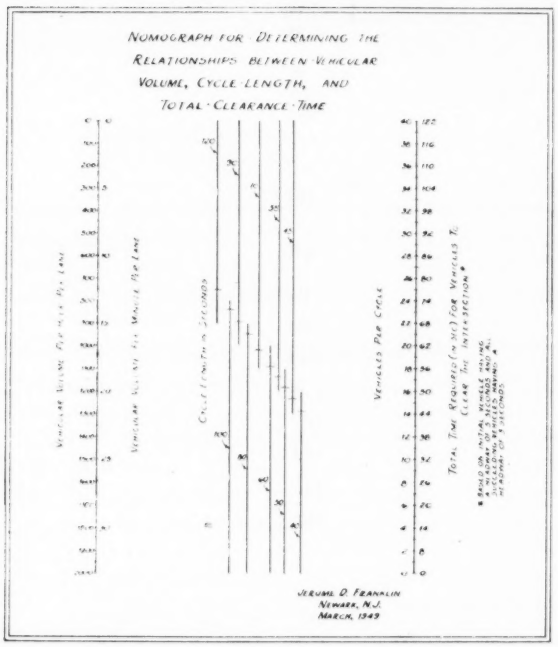
(1) Connect the value 600 in the column at the left with the cross mark located at the top of the 60 second cycle located at the center;

(2) Extend the line to the column at the right and read 10 vehicles per cycle or 32 seconds, the time required for the vehicles to clear the intersection.

If for the same volume a 120 second cycle were to be adopted the nomograph would give respective values of 20 vehicles and 62 seconds.

A second use of this chart is that it can easily determine the peak loads that an intersection can handle, with the exclusion of the amber periods.

For example, if a traffic count showed that the heavier traveled major approach to an intersection handled a peak lane load of 630 vehicles, and the heavier traveled minor approach handled a peak load of 320 vehicles, for a total of 1050 vehicles, the chart shows that a cycle length *under*


NOMOGRAPH FOR DETERMINING THE
RELATIONSHIPS BETWEEN VEHICULAR
VOLUME, CYCLE LENGTH, AND
TOTAL CLEARANCE TIME
VEHICULAR VOLUME PER HOUR PER LANE
VEHICULAR VOLUME PER MINUTE PER LANE
CYCLE LENGTH IN SECONDS
VEHICLES PER CYCLE
TOTAL TIME REQUIRED (T+5N) FOR VEHICLES TO CLEAR THE INTERSECTION*
JEROME D. FRANKLIN
NEWARK, N.J.
MARCH, 1949

60 seconds could not handle the load effectively. This can be found as follows:

(1) Join 1050 in the left column with the 40 second cycle in the center and get a clearance time of 37.5 seconds. This amount is not satisfactory considering that about 6 seconds must be added to it because of the two amber periods, making a total minimum clearance time of 43.5 seconds;

(2) Similarly, the 45, 50, and 55 second cycles can be shown to be unsatisfactory.

The clearance time may vary in certain areas because of turning prohibitions, driver adaptation, etc. Values resulting from experiment in these localities may easily be substituted on the chart to cater to specific conditions.

ARBA - AASHO Cooperating Committee

Appointment of a cooperating committee for joint study of matters of mutual interest is announced by the American Road Builders' Association and the American Association of State Highway Officials. With increased efficiency in the highway industry and profession as its objective, the joint committee is expected to initiate a series of meetings and study projects at an early date.

Colonel E. R. Needles, American Road Builders' Association president, has named the following men to the ARBA committee: Hal G. Sours, consulting engineer of Columbus, Ohio, chairman; Alan Buck, Macon County superintendent of highways, Decatur, Ill., and president of the ARBA County Highway Officials' division; Joseph D. Donness, Milwaukee, Wis., contractor and vice-president of the ARBA Highway Contractors' division; A. B. Gay, Richmond, Va., contractor; Julien R. Steelman, vice-president, Koehring Co., Milwaukee, Wis., and H. H. Kranz, city engineer of Cincinnati, Ohio, president of the ARBA municipal division.

Members of the AASHO committee, as announced by C. W. Brown, that organization's president, are: C. M. Hathaway, Illinois, chairman; G. T. McCoy, California; J. A. Anderson, Virginia; G. A. Hill, Connecticut; E. L. Roettiger, Wisconsin, and A. C. Clark, Bureau of Public Roads, Washington, D. C.

ITE NEWS AND PERSONALS

400 ATTEND ANNUAL MEETING

The 20th Annual Meeting of the Institute of Traffic Engineers held at the Wardman Park Hotel in Washington, D. C. drew the largest attendance in the history of the organization. Nearly 400 highway and traffic engineers and their wives, from all parts of the United States, participated in the various technical and social events. The Annual Business Meeting on Sunday exceeded all previous attendance with approximately 100 members on hand to hear the various reports of officers and committee chairmen. Many important decisions were made at the Board Meetings and Annual Business Meeting that will be reported in later issues of "Traffic Engineering" magazine.

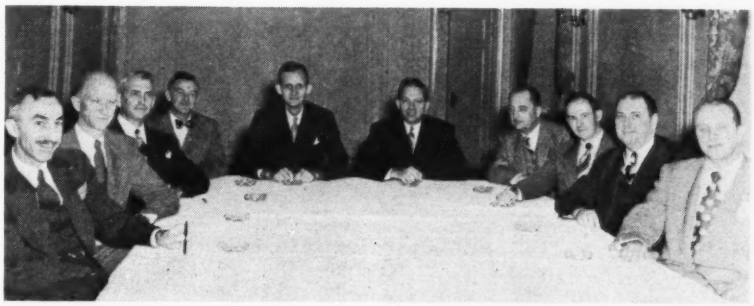
Among the important dignitaries in attendance at this meeting was André Rumpler, Director of Highways, France, a position comparable to that of Commissioner MacDonald of the U. S. Bureau of Public Roads.

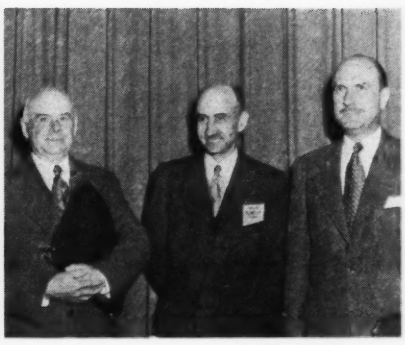
The newly elected president of the Institute, Wilbur S. Smith, opened the first technical session Monday morning by introducing Lieutenant Colonel L. E. Cox, Acting Engineer Commissioner, District of Columbia, who welcomed the delegates to the City of Washington. Colonel Cox indicated that motor vehicle registration in the District has been increasing since the war, and that approximately 50% of the vehicles using the complex street system in the city are registered outside of the District.

In response to the welcome extended by Colonel Cox, President Smith cited the growth of the Institute and called attention to the fact that when the last Annual Meeting of the Institute was held in Washington (in 1932) the total membership of I.T.E. was only slightly greater than the present membership of the Washington Section.

The highlight of the opening morning session was an address by Thomas H. MacDonald, Commissioner of Public Roads, Mr. MacDonald pointed out that traffic engineering and research have now been recognized as *necessities* in the planning and execution of highway development. He expressed confidence in the type of work being carried on by organizations such as the Institute and stated that, "sound development in planning and traffic engineering can come only through a thorough understanding and application of all the facts; and facts come only through painstaking research."

Commissioner MacDonald was followed by Mr. H. H. Kelly, Assistant Director, Office of Transport and





[1] The first official photograph is the new Board of Direction. Reading from left to right: Directors F. B. Crandall, E. J. Reeder, J. E. P. Darrell, Vice-President N. Cherniack, President Wilbur S. Smith, Secretary-Treasurer H. W. Osborne, immediate past president R. A. Mitchell, and Directors C. W. Prisk, D. M. McNeil and H. Porter Jr. Vice-President H. E. Neal was absent. [2] Lt. Col. L. E. Cox, Acting Engineer Commissioner for the District of Columbia, officially welcomes delegates to the 20th Annual Meeting. [3] Two of the principal speakers at the first technical session: Commissioner of Public Roads T. H. MacDonald, and Mr. H. H. Kelly, Assistant Director, Office of Transport Communications, Department of State, right. Shown in center is guest of honor Andre Rumpler, Director of Highways of France. [4] J. Ben Critz, Vice-President and General Manager, Dallas Chamber of Commerce, presents his views on public support at the opening session. [5] Tony Carrothers being "frisked" by Sergeants-at-Arms Bill Heath, left, and Lou Andriacchi, right.

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Communications, Department of State. He explained that the international aspects of traffic are now assuming major importance as indicated by the New Treaty on World Traffic signed in Geneva recently. This action will undoubtedly be a major contribution to the promotion of world peace and the extension of international commerce.

The session was closed with a paper on "Developing Public Support for Highway Improvement Programs" presented by Mr. J. Ben Critz, Vice President and General Manager, Dallas Chamber of Commerce. Mr. Critz stated that the public should be continuously informed of proposed traffic improvements as the most effective method of assuring their support.

Mr. Earl J. Reeder, Director, Department of Traffic and Transportation, Miami, Florida, opened the afternoon session by introducing a panel of traffic engineers who were to discuss "Recent Changes in Traffic Engineering Organization." These men included: T. T. Wiley, Director, Department of Traffic Engineering, New York City; J. E. Havenner, Manager, Public Safety Department, Auto Club of Southern California, and a member of the Traffic Survey Committee of the City of Los Angeles; Dwight T. Myers, Traffic Engineer, City of Providence, R. I.; and James T. White, Traffic Engineer, City of Evansville, Indiana.

Each of the panel members described the administrative organization of his traffic engineering department and the functions of that department as it relates to other governmental units in the community. Summarizing the panel presentation, Mr. Reeder explained that the organizations represented by the panel differed in detail but that they reflected a favorable trend in the expansion of the traffic engineering profession, particularly the tendency to place traffic engineering on a level with other major functions of state and city government.

Mr. Norman Hebden, Research Associate of the Yale Bureau of Highway Traffic, presented a paper on "State-City Relations in Traffic Affairs," summarizing the results of case studies of twelve cities and twelve states, geographically representative of all sections of the United States. This study, under the auspices of the Sloan Foundation, was initiated to determine the relationships existing between states and cities with respect to highway planning, construction, operation, maintenance, and other major traffic functions. Pointing out the shift in emphasis from rural to urban highway problems, Mr. Hebden explained that many states offer financical assistance to cities, others offer services, and still others offer both. It was emphasized that there is need for radical organizational changes at either state or city level, but a harmonious relationship must prevail to jointly plan, establish and maintain an adequate urban highway system in a cooperative manner. The initiative must stem from state level, with active cooperation and understanding on the part of city officials.

"Determinants in Annual Traffic Safety Award and I.T.E. Award for Excellence in Traffic Engineering" was the subject of the closing paper by Mr.

Harry Porter Jr., Traffic Engineer of the National Safety Council. Mr. Porter briefly outlined the history of the National Traffic Safety Contest, now called the Annual Inventory of Traffic Safety Activities, and explained that the Board of Direction of the Institute has appointed a committee to study the engineering section and devise new standards to measure activity and advancement in traffic engineering. Porter listed, in general terms, the methods and standards now used in grading for the safety awards, emphasizing that the present forms are not final, but are subject to constant change.

(To be continued in November issue)

[6] Harold Hammond, "pinch-hitting" for absentee chairmen of the Resolutions Committee, prepares to start the festivities at the Biscuit Banter Breakfast. The glum look is occasioned by the "milk" diet. [7] Special door prizes were won by past president Mitchell. John Ecker, left, displays late model typewriter, while Mitchell warily prepares to open camera. "Emcee" Hammond, in background, explains that this equipment will assure Mitchell a fellowship to the Yale Bureau of Highway Traffic. [8] "Five Percenters" being considered for expulsion at a special Board Meeting during the Biscuit Banter Breakfast. From left to right, Hank Evans (camera shy), Bob Burch, Ted Holmes (full member), Fred Fisch (in disguise), Frank Twiss, and, cowering below, Lloyd Braff. [9] Grand award for excellence in traffic engineering went to the "Gentleman from Kickapoo," shown in this photograph with his prize.

Open Discussion

Ed. Note: The author of the following discussion has a sincere desire to present this problem before the readers of "Traffic Engineering" magazine. He especially requested to remain anonymous to avoid any possible embarrassment to the organization with which he is employed. Since he is a subscriber to "Traffic Engineering" we invite discussion of the issue he raises. We feel certain that he would appreciate further comment.

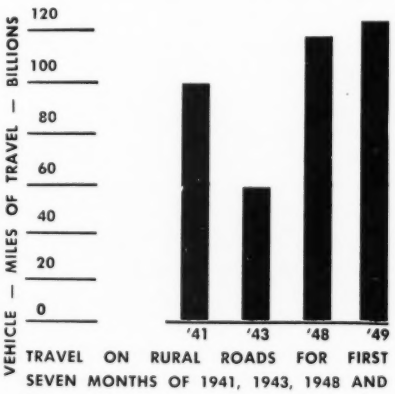
Highways are constructed and maintained by the government for the convenience of the public so that travel from one section to another can be a pleasure, instead of a hazard, and for quick dispatch of mail, etc.

However, these public roads are being used today by types of buses and trailer trucks for hire that were never contemplated nor even visualized fifteen years ago. Today, we encounter box cars, tank cars, and passenger cars on our highways that are a hazard to drivers of passenger automobiles. Thousands of drivers fear them, and, in passing, close their eyes in dread. This condition is found close to all of our cities and industrial centers.

These leviathans of the road should either be on the rails-roadway provided for the use of common carriers of persons and property—or they should build their own roadways from city to city, having their terminals on these private highways and enter the cities and towns only with their pick-up and delivery trucks, or taxi service for passengers.

There is an increase in unemployment to the extent of becoming an economic problem. Perhaps this would be the opportune time to start these highways, relieving the unemployment problem and at the same time removing the inconvenience, fear, and annoyance to the traveling public on our roads. No value has ever been given to the inconvenience created by the increasing number of these carriers for hire on our highways, but it is tremendous, and steps should be taken now to make them safer for the traveling public.

Traffic Trends



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New Appointments . . .

HARVEY D. BOOTH returned actively to the traffic field on July 16,

1949, when he accepted an appointment from Arkansas' Governor Sid McMath to head up the new State Safety program. His appointment carries multiple responsibilities, including that of Traffic Engineer for the State Highway Department, Executive Secretary of the Governor's Highway Safety Coordinating Committee, and Executive Director of a State Safety Council which is to be appointed later. As Traffic Engineer he will have direct responsibility for all traffic service facilities, traffic engineering assistance to local governmental units, and the general traffic engineering functions of the Highway Department.

He headed the Traffic and Safety Division of the Arkansas Highway Department from 1934 to 1941 when he became a traffic engineer with the National Safety Council, Chicago. While with the Council he served as Secretary of the Traffic Section and was active in all phases of the Coun-

(See BOOTH, *page 50)*

GEORGE T. PAPAGEORGE, Administrative Director of the Fulton County (Ga.) Planning Commission, was recently appointed Director of Public Works for Montgomery County, Maryland.

The Public Works Department will be split into divisions of highway engineering, trees, highway construction, maintenance and equipment, traffic engineering, and county buildings.

It will handle preparations of specifications for roads, bridges, culverts, and storm drains, engineering designs for county works, approval of subdivisions, issuing street building permits, preparing plans for public construction, and operation of a road material testing laboratory.

Planting and trimming trees, snow removal, street cleaning, erecting street signs, traffic studies and plan-

—Elliott's Peachtree Studio

ning, establishment of better traffic control through cooperation with police, street lighting, supervision of county building custodial services, and —if required by the board of education—provision of services for desig-

(See PAPAGEORGE, *page 50)*

FRANCIS E. TWISS recently was appointed as Director of Planning and

—photo by Harris & Ewing, Washington, D. C.

Economics for the International Road Federation according to a recent announcement by ROBERT O. SWAIN, who shortly before this moved up to the top position as Executive Director.

Frank assumed his new position on July 11, 1949 after working as highway specialist for the past year in the Transportation and Communication Department of the Chamber of Commerce of the United States. Prior to that he was Assistant Professor in the

(See TWISS, *page 52)*

SECTION NEWS

Florida Section

On Thursday, August 4, 1949, the Florida Section, ITE, held a joint meeting with the Southeast Florida Chapter of Illuminating Engineering Society. The luncheon meeting was held in Miami at the Seven Seas Restaurant. Mr. W. E. Whittaker, Jr., Illuminating Engineer, General Electric Company, spoke on the subject of "The Principles of Traffic Safety Lighting". Florida Section members attending included: Earl J. Reeder, Ed. Friedman, Walter Gottschalk, Ted Vanderstempel, Bill Folwell, Ray Sharp, Local Affiliate and Harley Wise, guest.

WALTER D. GOTTSCHALK,
Secretary

Michigan Section

The Michigan section of the ITE went "abroad" on June 29, 1949 to hold a meeting at the Toledo Yacht Club. A very successful program was presented under the chairmanship of Paul Robinette, Toledo's official sign hanger-upper.

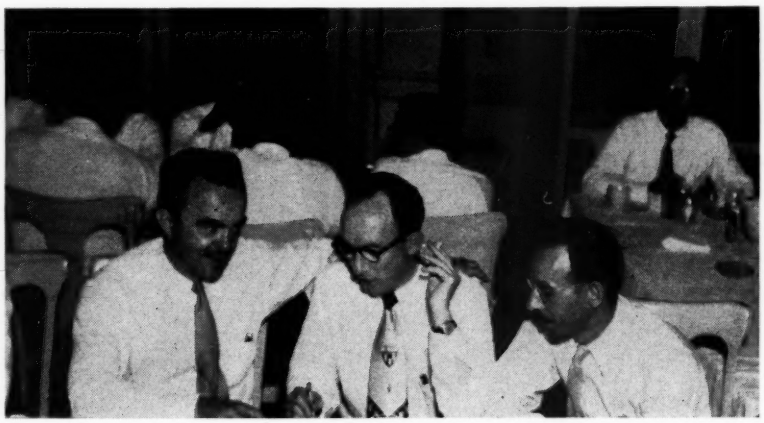
The more energetic members chased those little pellets around the golf course, while the rest enjoyed a siesta on the club's porches. After an excellent dinner, Mr. Robinette introduced some of Toledo's dignitaries including the city manager, Mr. Arnold Finch, and several ASF men working in the area under Grant Mickle's direction.

The Police and Firemen's Glee Club of Toledo presented an excellent program of music that highlighted a very successful meeting.

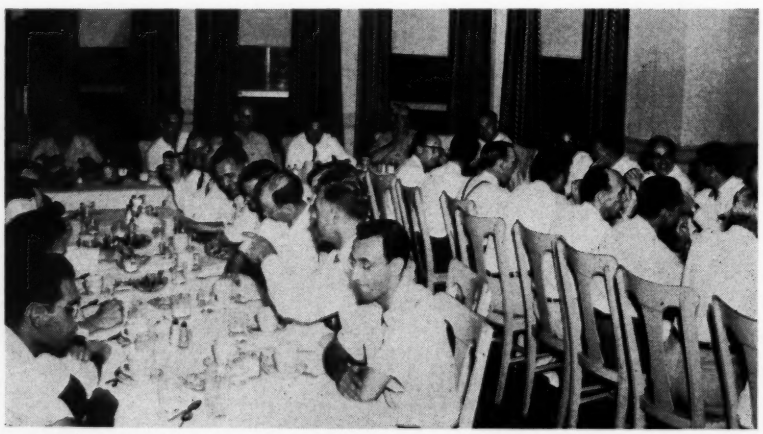
The Auto Club of Toledo exhibited some films extolling Ohio's virtues to impress the *Michiganders* and drum up the tourist trade.

To close the meeting, Mr. Robinette awarded prizes of tax-free Ohio firewater and buckets of paint to various and sundry golfers and liars including Gene Hibbard, Garn Griffin, Ross Harger, and Russ Harrison. There are no PGA prospects in the above group.

ARTHUR GIBSON,
Secretary-Treasurer



Carl McMonagle, center, is describing the "latest innovations" in Michigan to Grant Mickle, left, and Al Malo, right.
—photo by C. H. Brown



The above group photograph shows Michigan Section members enjoying dinner at their Toledo meeting. At speakers' table, left to right, Ross Harger, Arthur Gibson, Holden LeRoy, Arnold Finch, City Manager of Toledo, Paul Robinette and Harold Bauerle.
—photo by C. H. Brown

Western Section

The Second Annual Meeting of the Western Section, ITE, held in Portland, June 24 and 25, 1949, at the Hotel Multnomah, brought together 19 members of the *Institute* and 14 registered guests, as well as numerous others.

Immediately following registration, a business meeting was held. Newly elected officers of the Western Section for the 1949-1950 term of office are: President, James E. Reading; Vice-President, Fred T. Fowler; Secretary-Treasurer, J. Al Head. The business session included a discussion of proposed changes in the Section's Constitution and By-Laws and reports on area meetings from local chairmen. The Western Section, due to its extensive geographical spread, has designated local areas for meetings of members, as follows: Los Angeles, San Francisco, Oregon, Washington and Colorado. It was reported that the

James Reading extends sincere appreciation to the membership for the confidence expressed in his behalf by his election as President. Joe Havenner, far right, is "initiating" the new Secretary, Al Head, center, on his new duties.

Western Section was now the largest constituted of ITE and that the State of California ranks third in membership, just behind Illinois in second place and New York, the leading state.

At the Friday noon luncheon the Address of Welcome was delivered by Mrs. Dorothy McCullough Lee, Mayor of the City of Portland. Mayor Lee's address keynoted the Traffic Engineer and his part in public relations. She also stressed the need for closer cooperation between State and City engineering agencies since much routing of traffic within cities is by way of state highways. She said that Portland has taken a major step by placing the Traffic Engineering Bureau, the Traffic & Transportation Commission, and the Traffic Police all under the Department of Public Safety. In conclusion, Mrs. Lee urged due consideration for mass transportation problems and said people must be induced into using public transportation.

Friday afternoon's Technical Session No. 1 was presided over by David E. Morris, City Engineer of Tacoma.

Fred T. Fowler, Traffic Engineer, Portland, presented a paper on "One-way Street Grid for Portland". In conjunction with this talk, Fred displayed an experimental type illuminated "One-way" sign which he said is readable for two blocks. Mr. Fowler had a very interesting display showing the proposed one-way street grid for Portland west side business district and which showed, as well, the manner in which he anticipated the signing of the transition streets.

Emrys E. Lewarch, Assistant Traffic Engineer, Seattle, presented a discussion on "Positioning of Traffic Engineering Function in Government Organization". After a few brief, introductory remarks, Lew called upon various city and state people and had them give the positioning of their organization with relation to their governmental agency.

Shown at the speakers' table at the Friday noon luncheon, left to right, Joe Havenner, Arch Bollong, Jim Reading and Mayor Dorothy McCullough Lee, of Portland, who delivered the address of welcome.

Kenneth S. Vaughan-Birch, Traffic Engineer, Vancouver, British Columbia, gave a very interesting paper on "Traffic Signal Control" which treated primarily with a problem intersection in Vancouver and the manner in which they solved the intricacies encountered when mass transportation vehicles, pedestrians, and motor vehicles must be cared for simultaneously, and, at the same time heavy left turn volumes predominate.

At the dinner meeting the newly elected officers were installed by F. B. Crandall, Director of the Institute, the new officers being: James E. Reading, president; Fred T. Fowler, vice-president; J. Al. Head, secretary-treasurer. Concluding the installation there was an introduction of all those present, stating briefly the nature of their work and where they were located. John Carpenter, Director, Public Events Department, KOIN (CBS), Portland, was to have been the speaker of the evening but due to the unfortunate fire at Kaiser-Vancouver shipyards, he was called to cover this for KOIN. Presiding Officer J. E. Havenner, in collusion with F. B. Crandall, stuck William E. Weller, the Administrative Assistant to Mrs. Lee, with pinch-hitting for Mr. Carpenter. Bill delivered a very excellent talk, reiterating some of the shortcomings of the profession as he saw them, and stressing upon the fact that it behooved the traffic engineer to give consideration to others in implementing his ideas.

The Saturday morning Technical Session was presided over by W. E. "Skin" DeYoung, Division Manager, Automatic Signal Corporation, Los Angeles.

Henry K. Evans, Associate Engineer, Institute of Transportation and Traffic Engineering, Berkeley,* presented the first paper at this session. The subject of Hank's paper was "Research Activities of the Institute of Transportation and Traffic Engineering, University of California". As well as discussing the positioning of this organization in the

*Now a member of the staff of the Transportation and Communication Dept., Chamber of Commerce of the U. S.

Bruce Crandall, Director of ITE, officially installs the new officers of the Western Section. On Crandall's immediate left are Jay Czizek, outgoing Vice-President, and Al Head.

overall aspects of the Engineering School, Mr. Evans reviewed special projects being conducted, and equipment being developed not only by himself, but by other members of the staff and certain undergraduate and graduate students.

J. E. Havenner, Manager, Public Safety Department, Auto Club of Southern California, Los Angeles, delivered a paper on "Traffic Engineering Assistance for Smaller Communities". In this discussion he stressed the need of the smaller communities for assistance, and stated the policy of their department with regard to this assistance and their relation to public agencies and private engineering organizations.

Jay A. Czizek, Traffic Engineer, Oakland, concluded the morning session by delivering a paper on "On-Street Parking Before and After Installation of Meters". This paper stressed the improvement in turnover and the ability of the motoring public to find parking facilities available for their use in downtown Oakland. He also went into some of the considerations embodied in the placing of meters, method of operation, and enforcement.

Saturday afternoon's Technical Session was presided over by Winston H. Carsten, Assistant Planning Engineer, Washington Department of Highways, Olympia.

J. Al. Head, Assistant Traffic Engineer, Oregon State Highway Department, Salem, gave the second paper, on "Coordination of Traffic Engineering and Planning Survey Activities". In the course of presenting this discussion, Mr. Head deviated and put more emphasis upon the Planning Survey and its value to the operating Traffic Engineer. He stressed especially that the Planning Surveys are a storehouse of factual data which the Traffic Engineer should not hesitate to use.

Richard A. Wilson, District Traffic Engineer, California Division of Highways, Stockton, presented the third and final paper of the Saturday afternoon session, which treated with "Public Relations". Mr. Wilson summarized the public relations work carried on especially in his district, and the manner in which they sold certain of their ideas.

J. AL. HEAD
Secretary

Don't forget to order your copy of ANNUAL PROCEEDINGS of the INSTITUTE OF TRAFFIC ENGINEERS priced at $2.00 per copy.

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New Jersey Engineers Endorse Traffic Engineering Award

Ed. Note: The New Jersey Society of Professional Engineers, at its 25th Annual Convention on April 30, 1949, unanimously adopted the following resolution:

WHEREAS, the Institute of Traffic Engineers has awarded the State of New Jersey first place in the nation and the Eastern Region in traffic and highway engineering in the National Traffic Safety Contest, and

WHEREAS, this recognition for outstanding achievement in the engineering phase of highway safety was accomplished despite traffic and physical conditions which are in many respects unique in New Jersey.

NOW THEREFORE BE IT RESOLVED that the New Jersey Society of Professional Engineers here assembled at its Silver Anniversary Convention, extend its heartiest congratulations and commendation to the Division of Motor Vehicles of the Department of Law and Public Saefty, and the State Highway Department for this meritorious performance of their professional activities, and

BE IT RESOLVED that this Society endorse and encourage its members, particularly county and municipal engineers, to extend their efforts in the application of traffic engineering principles to the end that the efficiency and safety of highway traffic on all roadways of the State may be further improved, and

BE IT FURTHER RESOLVED that a copy of this resolution be forwarded to His Excellency Alfred E. Driscoll, Governor of the State of New Jersey; the Honorable Theodore D. Parsons, Attorney General; the Honorable Arthur W. Magee, Director, Division of Motor Vehicles, and the Honorable Spencer Miller, Jr., State Highway Commissioner, and the New Jersey State Police.

The above photograph shows Mr. Robert A. Mitchell, President, Institute of Traffic Engineers, officially presenting the special achievement award in traffic engineering to Governor Alfred E. Driscoll of New Jersey on June 7, 1949. New Jersey won first place in the Eastern region for outstanding performance in traffic engineering. Flanking the Governor and President Mitchell are, left, Arnold H. Vey, State Traffic Engineer, and right, Arthur W. Magee, Director of Motor Vehicles.

Second Missouri Traffic Engineering Conference

Plans for the handling of traffic should be based on facts after a thorough study of all the factors involved, whether on city streets or the highway, according to Wilbur S. Smith, Associate Director, Yale University Bureau of Highway Traffic, New Haven, Connecticut. A comprehensive and correlated program should be adopted. This seems to have been the consensus of opinions of those in attendance at the second annual convention of the Missouri Traffic Engineering Conference held at the Governor Hotel, Jefferson City, June 16, 17 and 18, under the auspices of the University of Missouri College of Engineering. The Missouri State Highway Department, the Yale University Bureau of Highway Traffic, the Institute of Traffic Engineers and the Missouri Municipal League cooperated in conducting the conference.

Mayor Otis L. Barbarick, Springfield, in his address on "Traffic Problems of Our Municipalities As Seen by a Municipal Official," listed three major problems for handling traffic: (1) Finances, (2) Moving traffic on the principal thoroughfares of the cities, (3) Parking facilities in the downtown areas. He pointed out that better parking facilities on lots supported by the citizenry of the communities would be of immeasurable benefit and recommended an enabling act to allow cities to secure property for parking areas. This could be extended to also include dangerous corners where the cities cou'd obtain sight distance right of way.

It was pointed out that the reasons our safety programs have failed has been because of the level at which we have tried to teach "stop" and "slow" slogans. Barbarick urged that educational programs at the elementary, grade school, high school and grandad levels would do much to solve in a measure this problem.

Wilbur S. Smith (Mem. ITE) called the attention of the convention to the production of motor vehicles which has been progressing at the rate of one-half million a month, or one million every two months. This production is saturating the capacities of our streets and highways.

M. Earl Campbell (Mem. ITE) Highway Research Board, reported on the President's Safety Conference and urged that traffic engineers apply five points in advancing this great program; public relations, regulations, control devices, consultation and design and research in an effort to achieve a reduction in the accident toll.

F. V. Reagel, chairman of the High-

Officials at the Missouri Traffic Engineering Conference are shown above, from left to right: Walter Ladd, manager of the St. Joseph Safety Council; Harry H. Harrison, traffic engineer of the Illinois Division of Highways; Carl W. Brown, chief engineer of the Missouri Highway Department and president of the American Association of State Highway Officials; Wilbur S. Smith, associate director, Yale University Bureau of Highway Traffic, New Haven, Connecticut.

way Research Board and Engineer of the Materials Bureau, reported on "Some observations and studies on the use of reflecting spheres for Traffic Paint Stripes," as made by his department laboratories and field tests.

Myer Ableman, surveys and plans engineer, reviewed the many difficulties encountered in the Missouri Urban Highway Program, under the Federal Aid Highway Act of 1944.

J. A. Hutter, assistant Kansas City, Mo., traffic engineer, told of planning traffic regulations and how important it was in their city that they initiate a program to create interest and from that an eventual good program resulted.

George J. Fisher (Mem. ITE), traffic engineer, City of Wichita, Kansas, in speaking on a blanket speed law for a state called attention to the difficulties that would be encountered. Some highways built in the early 20's would have to have a 35 miles an hour safe speed limit whereas the modern wide highways could operate with a 70 mile an hour safe speed law. A maximum speed law would not give a solution to this problem if one were put in effect and the enforcement would be impossible, Mr. Fisher said.

Harry Harrison (Mem. ITE), traffic engineer for the Illinois State Division of Highways, reported on the growth of outdoor theatres in his state and the difficulties encountered in the handling of traffic along the highways. The 53 show houses now operating have cooperated with the state officials in the movement of traffic in and out of the grounds.

Seven states were represented at the conference, with Kansas, Oklahoma, Arkansas, Illinois, Connecticut, Washington, D. C., and thirty-one Missouri cities having representatives present.

A number of visitors were taken on an inspection trip to the headquarters garage to see Missouri's centerstriping equipment and the sign paint shop.

On May 26, 1949, Mr. Harry Porter, Jr., third from left, Director of the Institute of Traffic Engineers, officially presented Mayor Shock the plaque won by South Bend, Indiana, for its outstanding traffic engineering record in 1948. Looking on at extreme left is E. H. Miller, City Traffic Engineer. Other city officials were present for the ceremonies.

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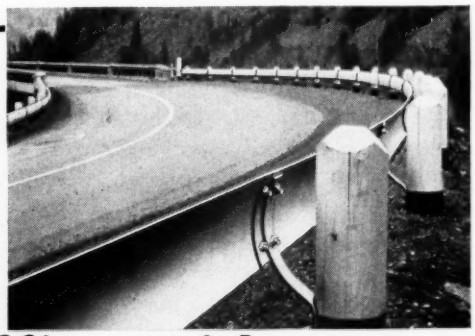

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Personalities . . .

HAROLD F. HAMMOND was born in Nebraska in 1908, the only son of a Presbyterian minister. He received his high school education "out where the tall corn grows" in

—Chase-Statler Photo
Washington, D. C.

Red Oak, Iowa. Here we have the first hint of the close relationship between Harold and Grant Mickle. It appears that Grant was a long-time resident of Red Oak and "teamed up" with Harold in high school.

The University of Michigan seems to have lured many ITE members to its environs. Undoubtedly, Professor Morrison had something to do with this inducement. Harold received his B.S. degree in Civil Engineering from Michigan in 1930 and became interested in traffic engineering while taking one of Morrison's traffic courses. Through the excellent cooperation of Prof. Morrison, Harold (teamed up again with Grant Mickle) obtained an Erskine Fellowship to the Bureau for Street Traffic Research, then at Harvard University. He received an M.S. degree in Civil Engineering from Harvard in 1931. At this point, there is an indication that Hammond, Mickle and McClintock were granted some type of "travelling" fellowship from Harvard. In any event, the trio purchased a car and spent three months observing and studying traffic conditions in all American cities of one-half million population.

Hammond served as the first Traffic Engineer of the Governor's Committee on Street and Highway Safety for the Commonwealth of Massachusetts. Later as Traffic Specialist for the Traffic Audit Bureau, he conducted traffic studies of outdoor advertising along the eastern seaboard from Maine to South Carolina.

He joined the National Conservation Bureau in New York in 1935 as Director of the Traffic and Transportation Division. During the early part of the war he took leave to serve as traffic and transportation consultant for numerous cities, aircraft plants, Norfolk Naval Operating Base and ODT.

He resigned from the National Conservation Bureau to become Washington Manager for American Transit Association in the fall of 1944. After serving in this capacity for a brief period he joined the U. S. Chamber in 1947 as Assistant Manager, Transportation and Communication Department and became Manager of the Department in 1948.

Harold has long been an active member of the *Institute* and holds the distinction of serving longest (12 years) as a member of its Board of Direction, starting as Secretary in 1935. He later held the office of Vice-President and President. He recalls that, although the Institute was numerically small, in the early days, the secretarial job was quite tough. "Traffic Engineering" magazine was only a mimeographed job in those days.

(See HAMMOND, *page 54)*

Litchfield, Conn., was the birthplace of HENRY WATSON OSBORNE (Ozzy), traffic engineer and advisor to the Buffalo (N. Y.) Board of Safety. But the New England landscape didn't

enjoy his presence for long. At the age of 9, he was taken to Trenton, N. J., by his parents.

From Trenton, Osborne went to Milwaukee in pursuit of education, and there he found plenty of it. He entered the College of Electrical Engineering, Milwaukee School of Engineering, balancing his engineering studies at the same time with an all-around outside education in such worldly occupations as bussboy, elevator operator, auto jockey, garage attendant and private chauffeur—all in the short span of four years.

A B.S. degree in electrical engineering was all too little education for Osborne, and in 1931 he entered the University of Wisconsin's Extension Division, taking up such diverse subjects as investments, business finance, public utilities, steel design, a structural theory and symmetrical components. In 1935 he completed a course in metallurgy and electric arc welding at MSOE.

While acquiring this schooling, he was getting further education in public employment. In 1931 he started

(See OSBORNE, *page 54)*

BOOTH . . .

(Continued from page 43)

cil's traffic safety program. A lawyer, he was one of the leaders in the cooperative Traffic Court Program sponsored by the National Safety Council and the American Bar Association. He served as a part-time instructor on the staff of Northwestern University Traffic Institute. In 1946 he took a leave of absence from the Council to recuperate from an illness, and engaged in private law practice and managed a title company in Maryland. Recently he returned to Arkansas and had been practicing law and managing a business in Benton, where he will continue to reside. He has fully regained his health.

A native af Kansas, he removed to Arkansas at an early age, received his AB degree from Arkansas College in 1929; an LL B degree from Arkansas Law School in 1935 and in between did most of the residence study for an MS degree at the University of Southern California. He is a member of the Institute of Traffic Engineers, the American Bar Association and various local bar groups and committees, the American Legion and the Rotary Club. In legal circles, he has been admitted to practice in Arkansas, Federal District Courts, and the United States Supreme Court.

PAPAGEORGE . . .

(Continued from page 43)

nating school buildings and negotiating for school sites, will also be department functions.

Mr. Papageorge's experience includes work in road construction, storm drainage, bridges, erosion, traffic engineering, and other public works.

A graduate of Georgia Tech with a degree in civil engineering and also holder of the professional degree "Civil Engineering", Mr. Papageorge was selected for a graduate fellowship course at the Yale Bureau of Highway Traffic in 1940.

From 1925 to 1939, he served as Senior Resident Engineer for the State Highway Department of Georgia. The next two years he was Traffic Engineer for the Georgia Highway Department and later was Assistant State Director of Highway Planning.

He spent two years as Planning Engineer for the Federal Works Agency. He has also been director of Public Works Panel for the Agricultural and Industrial Development Board of Georgia.

From December 1946 to December 1947 he was an assistant vice-president with the Frederic R. Harris Engineering Corp., and the following year he did private consultant work.

Angling Variety

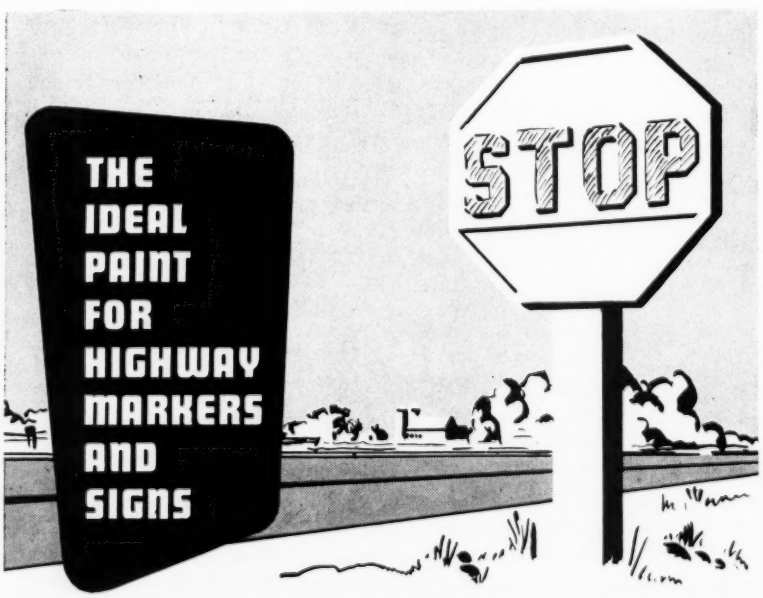
We'd find no fault with worms
that turn
If those ahead of us would learn
To signal what they aim to do
Before they execute a U.

CLIFF WALTERS
Pathfinder, 7/27/49

WEATHER PROOF

BY ACTUAL TESTS, a number of states have found NAZ-DAR Silk Screen Enamel FAR SUPERIOR to any other, and are using it with great satisfaction.

IT STANDS THE GAFF! Withstands exposure for indefinite periods . . . dries with a hard and tough surface with a fine glossy finish. Comes in paste form . . . 1 gallon will cover from 900 to 1200 sq. ft.



NAZ-DAR *Weatherproof* SILK SCREEN ENAMEL

HEADQUARTERS FOR ALL SILK SCREEN SUPPLIES — colors, silk, squeegees, stencil knives, etc.
Write for full information and prices.

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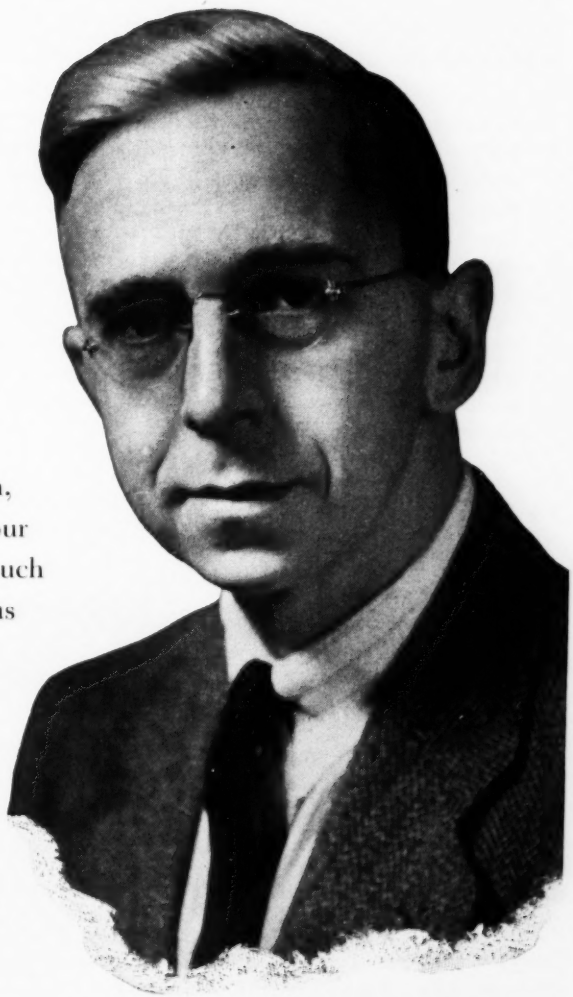
TE 10-49

"We consider our Street Lighting System an investment in *Good Living*"

Says Mayor **Horace S. Graham**
of Poughkeepsie, New York



"MODERN street lighting can be the means to end—or drastically reduce—traffic accidents at night and the incidence of crime."

"And," continues Mayor Horace S. Graham, "because of the *extra* benefits that accrue to our city by reason of our lighting system, benefits such as community development, civic pride, stimulus to retail trade and increase in real estate values, we consider it an investment in public safety and a higher standard of living."

Mayor Graham is just one of hundreds of alert, conscientious city officials who regard community welfare as a personal responsibility. And through the installation of modern street lighting, more and more cities are safeguarding the lives and interests of their townspeople.

FOR MORE FACTS

Write for your free copy of "A Planned Program for Better Street Lighting."

The Street and Traffic Safety Lighting Bureau, 155 East 44th St., New York 17, N. Y.

Several personnel changes were made recently in the Detroit Traffic Engineering Bureau. By special request, Al Malo, City Traffic Engineer, arranged the group photograph above to most effectively illustrate the re-organization. On Al Malo's immediate left is Ross Harger, Assistant City Traffic Engineer. The four men to Al's right direct the activities of the Traffic Control Division. Reading from right to left are: Holden LeRoy, Arthur Gibson, Frank Ronan, and Jack Petterman. The four men seated to the left of Harger direct the activities of the Planning Division. They are, left to right: John Dobelek, Stewart Gourlay, Albert Hanson, and Herman Batts, recently returned from a year's training at the Yale Bureau of Highway Traffic. Another member of the staff, Mr. Sven Kansman, not shown, completed the course at Yale with Mr. Batts.

Car Paint Jobs

With 13 million cars and 2.4 million trucks in U. S. now over 10 years old, compared to 5 million cars and one million trucks beyond that age in 1941, body repair and paint shops report business has zoomed since the war.

One motor service publication estimates that complete new paint jobs totaled 1,621,000 last year, compared to 577,000 in 1945. Before the war, new paint jobs on motor vehicles were rare—for the average car was junked when slightly over 10 years old.

The same publication estimates there were 5,500,000 body repair jobs done in 1948, compared to 3,600,000 in 1945.

Automobile Facts

PLEASE BUY FROM TRAFFIC ENGINEERING ADVERTISERS

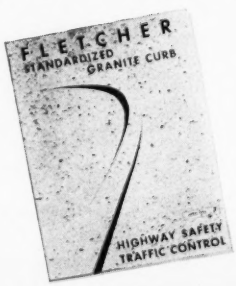
TWISS . . .

(Continued from page 43)

Bureau of Highway Traffic at Yale in charge of the traffic engineering program for two classes of army students.

Frank received his undergraduate education from Rensselaer Polytechnic Institute at Troy, N. Y., having been graduated with a degree of Civil Engineer in 1934. Prior to World War II he worked on highway planning and traffic engineering in and around Hartford, Connecticut. He attended the Bureau of Highway Traffic in 1938-1939 and then returned to Hartford as traffic engineer in the City Engineer's office. He served in the Civil Engineer Corps of the U. S. Navy from 1942 to 1946, being released to inactive duty as a Lieutenant Commander. He is a registered Professional Engineer in the State of Connecticut and an associate member of the American Society of Civil Engineers.

YOURS FOR THE ASKING.....



A NEW GRANITE CURB FOLDER 7T—Containing complete specifications on fabrication and setting of Standardized Granite Curb, also detail drawing of high speed highway entrances and exits. Every traffic engineer should have it.—Write for your free copy today.

H. E. FLETCHER CO.
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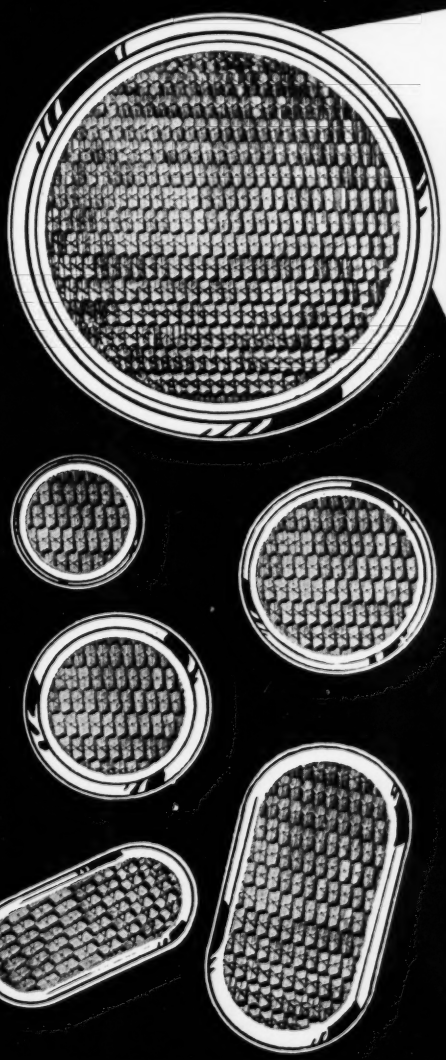


A GROTE REFLECTORIZED SIGN IS THE BRIGHTEST MESSAGE ON THE ROAD

GREATER HIGHWAY SAFETY

Grotelite PRISMATIC REFLECTORS

Now brighter—more dependable than ever before, Grotelite Prismatic Reflectors are the most effective reflectors for all caution and warning signs. Sealed to protect against dirt and moisture, Grotelite Prismatic Reflectors are brighter—clearly visible at greater range—safer, because they reflect the warning message—impel obedience to the authority of all traffic signs. Grotelite reflectorized signs are the kind that make motorists STOP — LOOK — and LIVE.

FOR FAR-SIGHTED ECONOMY, USE SAFETY-WISE GROTELITE REFLECTORS

Use economical Grotelite Prismatics for signs made in your state or municipal sign shop. Write for details and new low prices.

Grote

The GROTE MFG. CO., INC.

GROTE SQUARE, BELLEVUE, KY.

Opposite Cincinnati

HAMMOND . . .

(Continued from page 49)

Harold is reticent to enumerate on the many important assignments during his varied and active career, but we do know that he was formerly guest instructor at the F.B.I. Police Academy and for numerous short courses in traffic engineering and police training schools throughout the country. He was also instructor of several full semester basic and advanced traffic engineering courses at Rutgers prior to the war. He served on many national traffic committees between 1935 and 1945. He was co-author of numerous traffic engineering manuals and publications.

He is a registered professional engineer in the State of New Jersey and an Associate member of ASCE.

Harold now resides in Silver Springs, Maryland, a Washington suburban community, and finds plenty to do at home in his spare time to keep out of trouble. He has accumulated an envious collection of lathes, saws, drill presses, and other mechanical tools to keep him busy refinishing antique furniture and building new "gadgets" for his home. He became so enthused with his work-shop that he decided to expand operation and built a swimming pool. He states that no man in his right mind will build more than one swimming pool in 99 years. He further states that he does not expect to live that long! In any event, the pool has been the scene for the annual summer outing of the Washington Section, ITE, since its construction three years ago. Harold's other chief hobby is a close secret which can be revealed when guests arrive at his domicile.

OSBORNE . . .

(Continued from page 49)

with the Bureau of Electrical Service, Milwaukee Department of Public Works—*washing street lights.* After seven weeks with the soap suds, he made bold to approach the boss for a position and was promised a better job "starting Monday." Come the impatiently-awaited day and Osborne was graduated to operating an air compressor, breaking up street pavement, and digging up streetcar rails and underground cable.

Undaunted, he went on into electrical substation construction work for the city and began his first traffic survey and engineering work. Here he gained practical experience in substation construction, installation of street lighting equipment and underground circuits, and familiarized himself with all phases of Milwaukee's traffic control system.

Transferred to the Engineering Division of the Bureau of Electrical Service in January, 1935, he picked up additional experience that has since proved helpful—experience in drafting, street lighting and traffic control design. In this division, he successively held the position of electrical mechanics helper, electrical and layout draftsman and junior engineer.

He took leave of absence from his city job in the fall of 1936 to do graduate study in traffic engineering on a partial fellowship at Harvard University. There he worked with Dr. Harry DeSilva. In charge of the motor vehicle administration research laboratory, Osborne had a part in the designing and construction of the early driver-reaction machines used by several national organizations.

Upon graduation from the Harvard Traffic Research Bureau, he returned to the City of Milwaukee's Bureau of Electrical Service to supervise a WPA traffic survey whose purpose was to bring up to date all traffic control records and drawings. From this study, improvements were recommended in traffic control signs and signals, paint lines, street lighting and channelization of irregular intersections.

His desire to learn more concerning the theory of traffic engineering won him a fellowship at Yale University's Bureau of Highway Traffic in 1938. Following his studies at Yale he was appointed traffic engineer for the City of Flint, Michigan, on March 1, 1939, where for nearly three years he had charge of the Police Department's Traffic Engineering Division.

In November, 1941, he went to Buffalo, where his aim was to put Buffalo in the leading position among cities of comparable size. As the result of improvements which followed his appointment, Buffalo not long afterward rose to a high place in the coveted circle of the nation's safest cities—for the first time. Ultimately, he insists, in his determined way, Buffalo can and will be the nation's safest city.

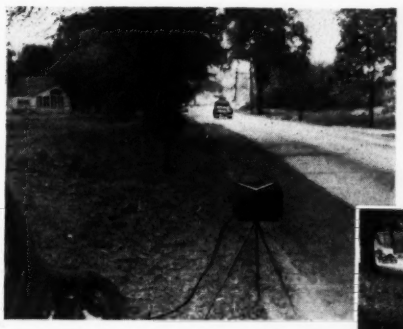
His time-consuming efforts in this direction leave little room for "extra-curricular activities," but he is past chairman of the Western New York Section, Illuminating Engineering Society and for the past year has served on his church council. He qualified to practice professional engineering in New York State in 1946. His affiliations with engineering and research groups are many and varied, and point up his active interest in the advancement of traffic engineering and related fields. His "first love" has continued to be the Institute of Traffic Engineers. After serving on the Board of Direction for two years and losing re-election by the margin of *one* vote, he has again been re-elected to the Board—this time as Secretary-Treasurer.

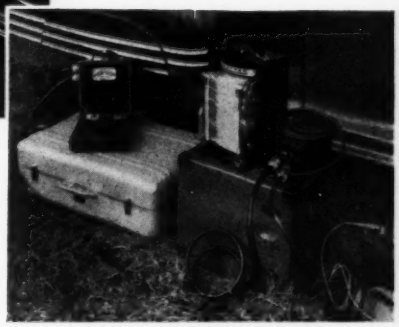
Of all the widely-separated places he has called "home" in his 41 years, none, in fact, lasted very long. Almost every decade, or less, found Osborne "on the move." This, of course, has gained him a wide acquaintance and extensive experience in a comparatively short span.

His favorite pastime today—fishing—which Osborne thoroughly enjoys but too-infrequently finds time to indulge in—is a throwback to earlier carefree days of his youth. Despite the fact he spends less time than he'd like to at this leisure-time activity, he nevertheless can tell those "tall ones" about as well as old-timers at the game and better than most fishermen.

Besides fishing, he is trying to squeeze out enough time to get back to golf, do some target shooting and relax in his basement workshop. Eventually he hopes to build his own home. There are two little Osborne boys—James Watson, 8, and Richard Cogswell, 5, and lovely wife, Anita, who thoroughly enjoys "Traffic Engineering" magazine and annual conventions.

ELECTRO-MATIC SPEED METER





- EASY PORTABILITY

- NO ROAD TUBES OR WIRES
- CAR BATTERY OPERATION
- MICROWAVE ACCURACY

Electro-Matic Speed Meter, Model S-1, is a precision instrument for measuring the speeds of moving vehicles. It uses radio frequency microwaves and there are no tubes or wires in the highway. It operates from a 6 volt automobile battery (8 amp. drain) or from a 120 volt 50-60 cycle AC supply (50 watt rating). Accuracy is within 2 miles per hour within a speed range of 0 to 100 miles.

For operating convenience the Speed Meter is in 3 parts; Antenna Unit, Indicator Unit, Power Unit. The Antenna Unit is beamed at oncoming or receding traffic and may be located in a parked car or set up near the roadway. At the convenience of the operator the Indicator Unit and the Power Unit may be placed within or without the car. An aluminum carrying case is provided to contain the 3 units and connecting cables — total weight about 45 lbs.

The instrument is quickly set up and connected, ready for operation after a minute or so for heating tubes. Under average conditions operating zone is about 150 ft. in advance of Antenna Unit. Continuous speed measurement is made of vehicles moving within the direct microwave radiation path.

When a permanent record of speed readings is desired a Graphic Recorder is connected in circuit with the Speed Meter. The recorder is spring wound, is usually operated at a speed of 1½ in. per minute and has a capacity of 100 ft. of tape.

AUTOMATIC SIGNAL DIVISION

EASTERN INDUSTRIES INC.

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Autos Safe in Thunder Storms

You're safest in an automobile when lightning strikes! Recently, during a man-made storm in a research laboratory, a 3,000,000-volt charge of lightning was fired at a passenger car to determine what happens when the elements gang up on Mr. Motorist.

Result: Even the engineer who sat at the steering wheel throughout the experiments didn't mind. The vehicle acted as a lightning-proof cage, diverting the heavy currents harmlessly around the passenger. Only a small scorched spot on the car's metal top remained as evidence of the dramatic test.

Highway Research Abstracts, July, 1949. The Automobilist, Vol. 33, No. 3, July, 1949.

Long - Winded Orations Out of Date

A gadget that forms an integral part of the Illinois House of Representatives at Springfield is the M. H. Rhodes Mark-Time Timer on Speaker Paul Powell's dias. It registers the passing of time in minutes. Whenever a long-winded speaker gets under way to rumble on and on, at the end of five minutes the little timer automatically tolls a bell. Should he still continue after this warning which usually causes the startled orator to pause, the resonant voice of Speaker Powell booms, "Time's up." No one has yet thought to introduce a bill to allow mechanical timers in the Illinois General Assembly.

Second Annual Northwest Traffic Eng. Conference

The second annual Northwest Traffic Engineering Conference, sponsored by the Western Section of the Institute of Traffic Engineers, Washington State Highway Department, Association of Washington Cities, and the University of Washington, was held in Seattle on July 13, 14, and 15. There were some sixty in attendance, a majority of whom are shown in the group photograph above.

Representatives of the Bureau of Public Roads, cities and the states of both Oregon and Washington were well represented. ITE members took a prominent part in the program in delivering papers and participating in discussions. The following members of the *Institute* were present: Harry Aumack, Russ Bates, Don Berry, Arch Bollong, Bob Dunn, Fred Fowler, Bob Glenn, Al Head, Emrys Lewarch, Bill Stancer, Bob Schmidt and Dave Morris.

Obituary

James G. Hayden (Mem. ITE), son of Attorney and Mrs. Asa K. Hayden, passed away at the Pawating Hospital in Niles August 10, following an illness of several months.

He was born in Cassopolis April 13, 1907, attending the Cassopolis schools, where he graduated. He then entered Michigan State College, where he was prominent in campus activities and played on the football team. Graduating in engineering, he went with the Michigan Highway Department. Later he was with the National Safety Council, with offices in Chicago. Leaving the Safety Council, he became associated with truck lines as a traffic expert. About four years ago he went with the government as a traffic expert and was sent to Germany as traffic engineer in the American Zone, with headquarters at Frankfurt.

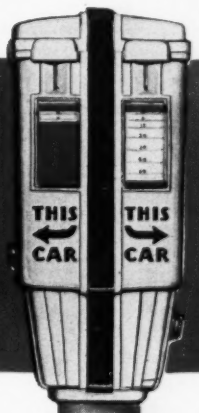
He became ill and was flown back to the United States in April and to the government hospital at Fort Custer. From Custer he was taken to the University Hospital at Ann Arbor, and five weeks ago was brought to the Pawating Hospital in Niles, where he died.

Jim has long been an active member of the *Institute*. He was first elected to membership in October 1936. A majority of the membership, particularly the old timers, will certainly miss the interest and support he has given the organization since that time.

Alfco TWIN AUTOMATIC PARKING METERS

"THEY HAVE ABSOLUTELY SOLVED OUR PARKING AND TRAFFIC PROBLEMS"

— MAYOR WALTER M. NEWTON
BENNETTSVILLE, S. C.



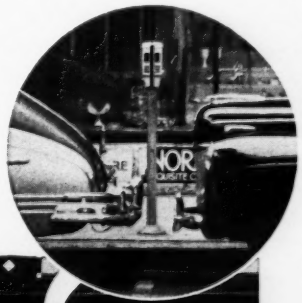
MAYOR Newton's statement is characteristic of many others. From all over America—wherever Alfco Twin Automatic Parking Meters have been installed—come favorable reports about the economy, the convenience, and the added safety factors of the Alfco Twin Automatic Parking Meters.

Only half as many meters to install . . . only half as many collections to make . . . only half the trouble to service and maintain—yet the Alfco Twins do a full-size job of parking control at only about half the cost of single meters! The Alfco Twin Meter method of parking bumper-to-bumper simplifies parking in busy downtown areas . . . more space for entry and exit . . . less danger of locked bumpers or dented fenders because the necessity of cramped maneuvering is eliminated.

Yes, Alfco Twin Automatic Parking Meters are winning new friends—all over America! Write today for full particulars and free illustrated literature.

Models Available To Suit Your Needs

Illustration shows how Bennettsville, S. C., applies the original Alfco Twin method of bumper-to-bumper parking.



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OTHER TRAFFIC NEWS

Memphis Creates New Traffic Advisory Commission

In a move designed to give Memphis a well rounded traffic control program, the City Commission recently passed an ordinance creating

a Traffic Advisory Commission. The Commission is to be made up of not less than twelve and not more than eighteen citizens to be selected by the City Commission from a cross-section of the city's business and civic interests. Besides the citizen members of the Commission, the ordinance calls for three ex-officio members: City Commissioner Boyle of the Department of Fire and Police; City Commissioner Williams of the Department of Public Works; and City Commissioner Fredericks of the Department of Public Service.

The ordinance provides for the appointment of a secretary to keep the commission books and records

Mayor Overton appointed William P. Huntzicker as Secretary of the Commission. Huntzicker was formerly Director of the Memphis and Shelby County Welfare Commission.

Joined Police In 1934

Mr. Huntzicker joined the Police Department in 1934. He was sent to the Northwestern University Traffic Institute for the 1938-39 school terms. There he studied traffic police administration, with emphasis on public relations, accident investigation, record analysis and driver education and training.

Later he was appointed record analyst for the Accident Prevention Bureau and held that position until he entered the Army in March, 1941. He served in the Military Police in North Africa, Italy and Sicily before returning to the United States for 13 months as safety director for the Second Army with headquarters in Baltimore. He is now a colonel in the Corps of Military Police Reserve.

Duties Are Described

The ordinance provides that duties of the Traffic Advisory Commission shall be:

". . . to study both general and specific problems of the City of Memphis relating to the flow of traffic, traffic safety, the parking of vehicles, both on and off-street, problems relating to specific intersection in the City of Memphis, and to make recommendations with reference thereto to the Board of Commissioners."

It also prescribes that the Traffic Commission shall hear "complaints and suggestions . . . and if necessary to hold hearings with reference to specific problems relating to traffic, traffic safety, traffic control, and parking" and make recommendations to the City Commission.

The ordinance calls for the new commission to hold monthly meetings and special meetings if necessary. It provides that the commission shall make an annual report each January on its work for the past year and make recommendations for "future projects to be undertaken for public improvement."

The appointment of the Traffic Advisory Commission will give Memphis what most traffic experts consider the basis for a well-rounded traffic program. Such a program includes: (1) traffic engineering, (2) adequate traffic law enforcement, and (3) public education and cooperation in traffic matters.

MARCH OF TIME Features Traffic Engineering

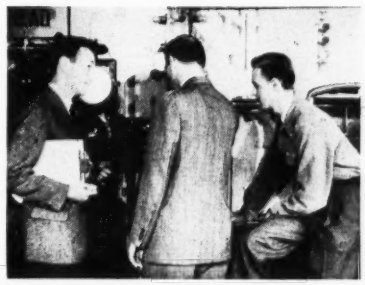
The MARCH OF TIME recently produced a film entitled "Stop—Heavy Traffic" as one of their series of motion picture news-of-the-day. The Yale Bureau of Highway Traffic was the scene of considerable activity the latter part of May when Twentieth Century Fox personnel and newsreel cameramen swarmed over Strathcona Hall to take pictures. Photos from actual scenes in the newsreel in the order in which they are presented are shown as follows:

A library scene
—The March of Time

To date, this is by far the best publicity that could be given to traffic engineering. It is hoped that other national organizations and magazines will recognize the importance of this

method of combatting the traffic problem.

A general laboratory scene
—The March of Time



Professor Hurd explains the intricacies of a traffic signal controller
—The March of Time

Professor Matson illustrates measuring of traffic
—The March of Time

Plastic Highway Markers

As a result of extensive research a new sign has been developed with emphasis on color permanency and corrosion resistance that employs a plastic material classified as *acetate butyrate*. This plastic is flexible and resiliant. Scratches and surface abrasions do not affect it. Because the color is an integral part of the material, the need for repainting is eliminated.

Sign shops employing legend paints which require oven drying at temperatures around 300° F. will find that the new plastic base legend paints will cure at the same rate at temperatures of less than 190° F. Acetate butyrate plastic becomes soft at temperatures exceeding 200° F. Generally speaking, they require more accurate heating control in the drying ovens than has heretofore been necessary with metal signs. Plastic materials lend themselves readily to spraying, silk screening, roller coating and transfer processes.

In some areas it has been the custom to clean signs with steam. While steam does not normally affect plastic signs, they are more easily cleaned by the use of detergents applied with brushes and then rinsed. When plastic signs become dirty after long periods of exposure, they can be revitalized by wire brushing.

Butyrate is easily reflectorized by any of the recognized methods. When the reflective coating is damaged, it exposes raw, non-corrosive butyrate of the same color. Scratches and abrasions of the reflector coat are virtually invisible.

Weathering tests have been conducted on acetate butyrate materials under the most severe climatic conditions for periods up to six years. These tests have been conducted both in Florida and Arizona, as well as in northern states under actual outdoor conditions. Weatherometer tests have been conducted by several private laboratories and the results have shown little or no change in the plastic material when exposed continuously, twenty-four hours a day, for periods of six months and over.

Police Chief Albert T. Cornish, Rocky River, Ohio, bends a COLUMBIA PLASTIC SIGN nearly double. The plastic sign springs back to its original shape when released.

Lt. R. Kelly points to revolver bullet marks on the plastic sign (top) and on metal sign (bottom). Plastic sign shows very little damage.

Shotgun pellets merely bounce off the sign while 22 calibre rifle slugs leave a hole slightly smaller than the diameter of the slug itself. The holes in the plastic sign can be mended by applying new material under heat. The new material bonds itself completely with the old.

The new plastic signs now offered by Columbia Sign and Signal Corporation of Cleveland, Ohio, are molded with the front face flat so that the blanks may be stocked by sign shops and legends added and altered as needed.

Mr. N. L. Mahla, Columbia's president, states that one of the major policies of the corporation is to aid and encourage the use of standard signs throughout the nation. The new Manual on Uniform Traffic Control Devices, issued by the Bureau of Public Roads in Washington, D. C., has become the accepted *standard* for Columbia. All of the tooling now in operation or contemplated is based on the standard sizes and shapes outlined in the new manual.

IMPORTANT

$1,000,000

IF

THEY STAY BRIGHT LONGER

Columbia Plastic Signs have the same brilliant color all THE WAY THROUGH—not merely a painted surface. The brilliant plastic pigments are non-fading, retaining their original brilliance throughout the long life of the sign.

THEY ARE NON-CORROSIVE

Columbia Signs completely resist the normal corrosive elements that cause deterioration of old-fashioned standard metal signs. The corrosion deterioration factor of these signs is practically zero per cent.

THEY RETAIN ORIGINAL SHAPE

Subjected to "torture tests", Columbia Signs were run over by cars, hammered, shot by pistols and shotguns, bruised by stones and other missiles. They showed a minimum of scars and always "snapped back" to their original shape.

THEY REQUIRE LESS MAINTENANCE

Once installed, Columbia Signs act as their own maintenance crew, making it unnecessary to remove them periodically for repairs, repainting, and other maintenance required by metal signs.

MAINTENANCE COST COMPARISON

Surveys made on Columbia Plastic Signs and old-style painted metal signs show that maintenance costs for various types of repairs and revitalization are so much less on Columbia Signs that there is actually no comparison. Maintenance costs on metal signs in many cases exceeded the original cost 200 to 300 per cent, while these same costs on Columbia Signs never exceeded 25% of the original cost. Translated into dollars this means that for every $1.00 invested in new signs $2.00 to $3.00 would be required to keep them in useful condition, while Columbia Signs required only 25 cents for the same job.

ESTIMATED REDUCTION IN HIGHWAY SIGN MAINTENANCE

THEY ARE COLUMBIA PLASTIC HIGHWAY SIGNS

No highway marker sign has ever offered all the advantages found in Columbia Signs. This new and revolutionary sign has "built-in" characteristics that make it far more resistant to the accepted forms of deterioration and damage than any other existing sign.

It can be beaten, run over, shot, hit with all types of missiles and still retain its full effectiveness. It withstands corrosive elements that normally ruin standard metal signs in a short period.

All these things add up to the most desirable quality in any highway sign—low maintenance cost, with more effective sign display.

Specifications complying with the Uniform Manual published by PRA available at no cost.

DOLLAR FOR DOLLAR . . . YEAR AFTER YEAR COLUMBIA SIGNS HAVE NO EQUAL IN MAINTENANCE SAVINGS

Remember

COLUMBIA LINE-O-LITE PAINTS

The most interesting thing that can be said about Columbia Line-O-Lite Traffic Paints is that "They make a longer, brighter, and more lasting line—at a material cost of .0021 cents per foot."

Write today for

COLUMBIA'S NEW FOLDER

1000% MORE COLOR

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Lyle

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THE MEN who are responsible for the erection and maintenance of signs are the best judges of sign values. They know the function of signs . . . and accordingly they know the qualities signs must have in order to serve their purpose.

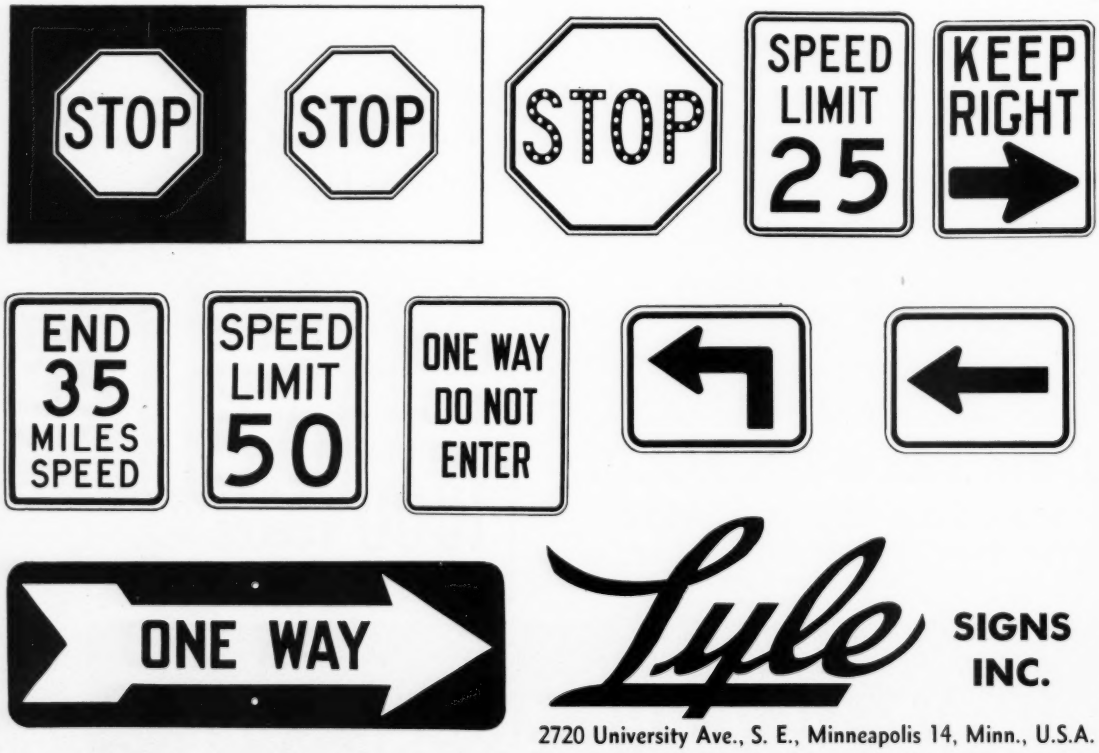
Signs carry messages to people. They give out warning, orders, instructions . . .

Therefore they must arrest attention . . . command respect . . . enforce their meaning . . . not only during the first week of their erection but for all the days in the future.

A sign must be quality built to do this job . . . to remain bright, shining and noticeable . . . for the only signs that are obeyed are those people notice.

35 years of sign design and manufacture go into Lyle Signs. This priceless, experienced "know how", builds into Lyle Signs these qualities that make Lyle Signs last longer, stay bright . . . and do a better job of functioning as a sign.

May we quote on your requirements . . . on Lyle Signs that cost less in the long run.



Lyle SIGNS INC.

2720 University Ave., S. E., Minneapolis 14, Minn., U.S.A.

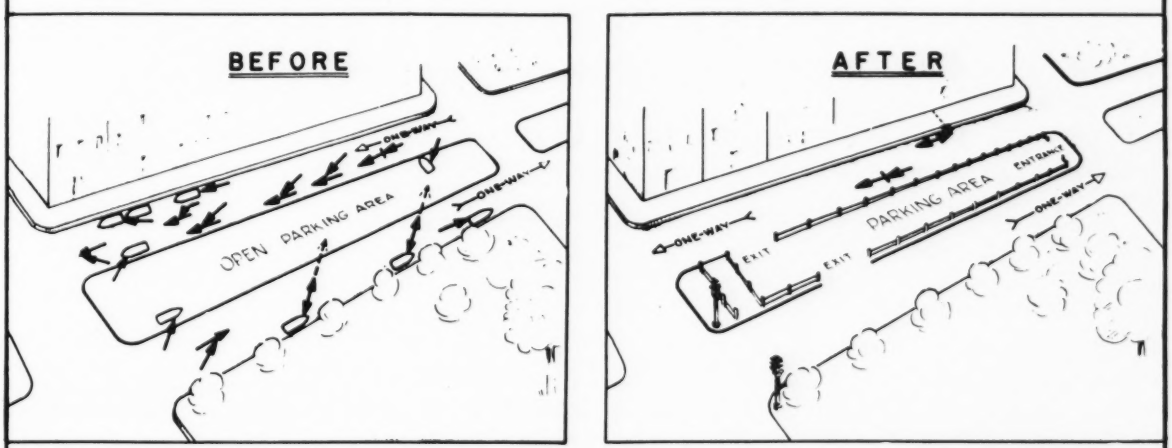
GETTING RESULTS

THROUGH TRAFFIC ENGINEERING

NO. 3

TRAFFIC SITUATION No. 3
PARKING ACCIDENTS ELIMINATED

PROBLEM: Fort Superhighway, a direct route from Detroit, Michigan to Toledo, Ohio consists of a right-of-way 204 feet wide and two 40 foot one-way pavements, separated by an 84 foot parkway or medial strip. It passes through a popular shopping center of Lincoln Park. Irregular parking practices at the curb and on the 84 foot medial strip created a serious accident problem.



ACCIDENT FACTS: Fifteen accidents occurred in one block of the Fort Superhighway during 1937 because of irregular parking practices. (See collision diagram above.) These accidents were due directly or indirectly to vehicles pulling into or out of parking spaces at curb or on medial strip.

FIELD STUDIES: A volume study showed a total of 10,145 vehicles southbound and 8,430 vehicles northbound during a 14 hour period. The average speed for each direction was observed as 34.6 mph southbound and 33.4 mph northbound. Ninety percent of the vehicles were operating at speeds under 42 and 38 mph south and north respectively.

SOLUTION: The medial strip was made an enclosed parking area by erecting a cable fence around it. The fence was placed 4 feet back from the pavement. An entrance was left at the north end, and two exits were established at the south end. A "U" turn area was also established at the south end, as shown in diagram above.

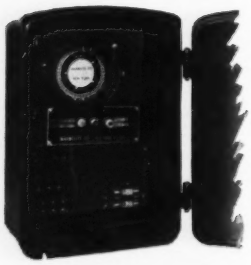
CHECK BACK: There were but two accidents since the change was made in January 1938 up to July 21, 1938. One occurred when a speeding driver overtook another car, the other when a car backing out of a curb parking space struck a vehicle going between that and another vehicle.

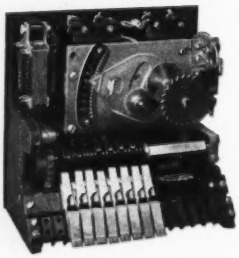
Ed. Note: Julien Harvey, Manager, Accident Prevention Department, Association of Casualty and Surety Companies, has kindly consented to allow us to reproduce selected "Getting Results Through Traffic Engineering" examples as a continuing series in TRAFFIC ENGINEERING magazine. It is our opinion that this series will serve as a review to those readers who have been receiving these examples regularly and will stimulate interest among the many readers to whom the examples are unknown. The Accident Prevention Department will be pleased to receive any new examples that interested engineers may have available. Individual examples are furnished gratis upon request. Further information can be obtained from the Accident Prevention Department, 60 John Street, New York 7, N. Y.

Example Contributed By

J. L. Wehmeyer, Traffic Engineer
Wayne County
Detroit, Mich.
Member, Institute of Traffic Engineers

The BIG Cities are using MARBELITE Traffic Signals and Controllers





. . . and there's a very good reason:

When cities like Los Angeles, New York, Philadelphia and some of the other BIG ones select MARBELITE Traffic Signals and Controllers, you know they've checked the field carefully . . . and from every angle. ADVANCED DESIGN, DEPENDABILITY and ECONOMY are basic considerations. If you use Traffic Control equipment, follow the BIG fellows, who specify MARBELITE.

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Please send me complete details of Marbelite Traffic Signals and Controllers used by the BIG cities.

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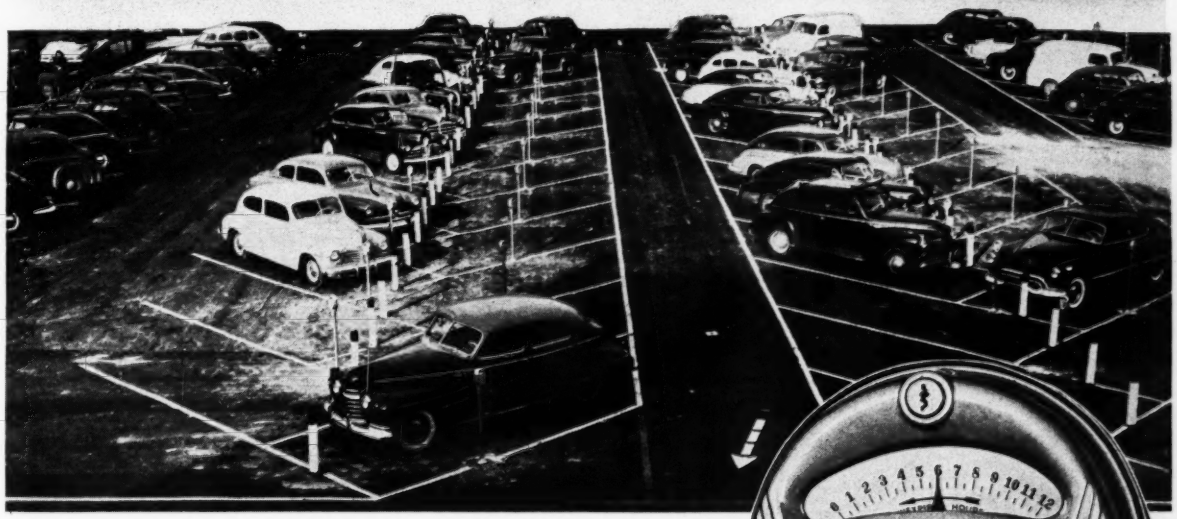
27 WARREN STREET - NEW YORK 7, N.Y.

DUAL AUTOMATICS

for OFF-STREET Metered Parking



DUAL *plus values* for on-street parking control are well-known, well-proved in hundreds of cities throughout North America. Now . . . these same advantageous qualities and features are available in Dual *off-street* Automatics—welcome news to many cities who recognize a serious need for expanded parking facilities to serve congested areas.

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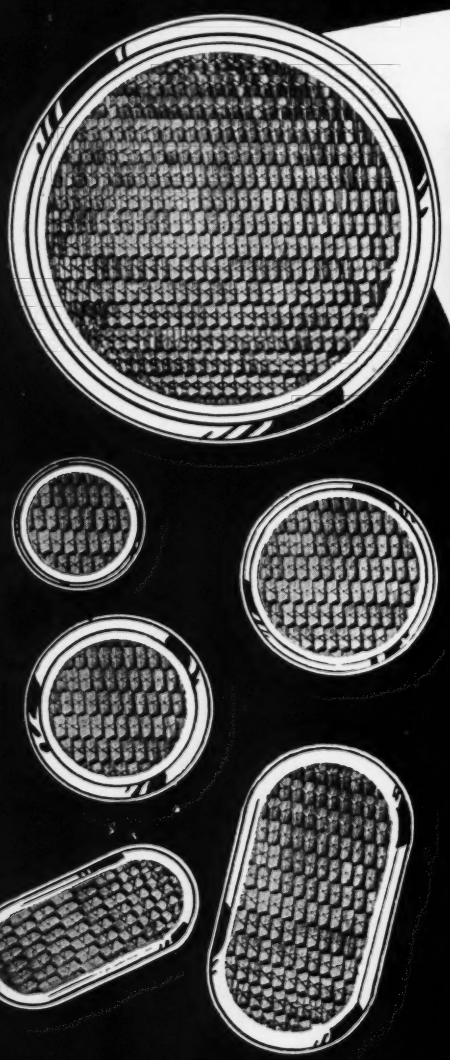

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